THE ILLUMINATING ENGINEER

LIGHT LAMPS FITTINGS AND ILLUMINATION

THE JOURNAL OF GOOD LIGHTING

. OIL . GAS ELECTRICITY ACETYLENE PETROL-AIR GAS ETC.

Official Organ of the Illuminating Engineering Society

FOUNDED IN LONDON 1908

Edited by LEON GASTER

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Special Features:

Public Lighting—A New Form of Illumination-Photometer—Electric Gasfilled Lamps for Kinema Theatres—Stage and Spectacular Lighting—Gas Lighting Improvements —A New Enclosed Flame Arc Lamp—News from Abroad, etc.

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The Fourth International Medical Congress on Industrial Accidents and Diseases

THE fourth International Congress on the above subject, held in Amsterdam during September 7th-12th, was the occasion of a gathering of hygienists and medical men from all parts of the world. Over 160 papers on the most varied aspects of industrial hygiene were presented. Some of these were primarily of a medical nature, but many points of general interest were raised. Of special interest was the paper on "Illumination of Workrooms," presented by Prof. F. Holtzman, who is associated with the Illuminating Engineering Institute at Karlsruhe, and the contribution of Dr. H. Bruns (Germany) on nystagmus amongst workers in the Ruhr mines. It is to be noted that Dr. Bruns—like most other experts who have studied this subject—comes to the conclusion that the disease is primarily due to inadequate illumination, and finds that conditions have improved with the introduction of electric lamps yielding a higher candle-power.

England was represented by a series of useful papers, amongst which may be noted the review by Sir Thomas Oliver of results of industrial legislation and industrial hygiene, the papers by Dr. Collis on the origin of lung diseases due to dust, and by Mr. H. M. Vernon and Mr. T. Bedford on ventilation and heating in factories.

Such a Congress, attended by medical experts concerned with industrial hygiene and industrial legislation from all the chief countries, naturally affords a good opportunity of drawing attention to the importance of good lighting in factories. The writer was, therefore, glad to accept an invitation to read a paper on this subject, which is summarized on pp. 243-244. Besides giving an account of recent international developments in this field, the paper was devoted largely to showing the need for research by medical experts and hygienists on many lighting problems, notably the degree of illumination desirable for different operations, and the analysis of glare. We have often pointed out what influential support would be afforded to advocates of better lighting if fuller data from the scientific and physiological side were forthcoming. The public has rightly come to attach great importance to the views expressed by the medical profession. It was very satisfactory at the Congress to note the general recognition that industrial lighting should be considered in the same category as proper ventilation, heating and sanitary arrangements as an essential in the modern factory.

The Congress was thus of direct interest to illuminating engineers, and provided a useful opportunity of meeting these various medical experts personally and establishing relations in foreign countries. Each Congress of this nature yields us new adherents to the movement for better lighting. On this occasion the writer had opportunities of meeting many medical men whose co-operation should be of great value to the international development of illuminating engineering. It was also a pleasure to meet again Dr. L. Carrozzi, representing the International Labour Department of the League of Nations. The House of Commons was represented by Dr. T. Watt and Dr. Vernon Davies, and the Home Office Factory Department by Dr. J. C. Bridge. Mr. D. R. Wilson, the indefatigable Secretary of the Industrial Fatigue Research Board, and Professor J. Glaister, on behalf of the British Medical Association, were also present.

During his stay in Amsterdam the writer had also opportunities of learning something of the operation of regulations on industrial lighting imposed in Holland—one of the very earliest countries to adopt legislation on the lighting of factories. In several respects the procedure is different from that in this country, but the principles underlying the regulations are substantially the same, and in Holland there is keen recognition of the need for good industrial lighting.

The Congress was an enjoyable event, and there can be no doubt that such opportunities for the exchange of information should receive every encouragement. At the same time, one is inclined to think that a limit to the number of papers should be set. The tendency at international gatherings to-day is for the number of communications to increase continually. On this occasion about 160 papers and communications were presented, with the result that there was insufficient time available for any detailed presentation of papers or effective discussion—especially as printed copies of the papers were not available, but only very brief abstracts. The pleasure of the gathering was enhanced by the characteristic hospitality of our Dutch hosts, who did everything possible to render our visit enjoyable. We noticed, however, in some quarters a disposition to think that this country was not assigned sufficient prominence. Any such impression could probably be traced to some defect in organization, which could be remedied in the future. A useful step would be the appointment of a Master of Ceremonies, with full experience of international affairs, who would organize the various functions so as to avoid any possible cause of offence or misunderstanding. This problem is apt to arise in all big international congresses, where undue preponderance of any national element should be avoided. It is of the greatest importance that on such occasions this country, which has done so much for industrial hygiene, should take a leading part.

Public Lighting

FROM the account of the proceedings at the Annual Meeting of the Institution of Public Lighting Engineers, given on pp. 246-248 in this issue, it will be seen that all the authors emphasized the need for better lighting in the interests of safety of traffic. Mr. Shapley, in his presidential address, recognized that public lighting had been much neglected during the war, and even to-day the lost ground has not been fully recovered. Yet it is generally admitted that not merely the restoration of pre-war lighting, but an improvement on this is needed. For conditions have changed materially since 1913. The volume of traffic during the past 12 years has increased enormously, and, as the statistics presented by the National Safety First Council show, the number of street accidents still shows serious increases year by year.

These facts are admitted by experts. They were emphasized at the I.M.E.A. Convention at Brighton. On that occasion the writer pointed out that the need of the present time is to convince those in whose hands decisions regarding improvements in public lighting rest—the Watching and Lighting Committees, and the Local Authorities throughout the country. It was satisfactory to note at the Leeds meeting a number of representatives of the Corporation of that city. No doubt, by a series of meetings held successively in the chief provincial cities, local pride in their lighting arrangements will be stimulated and good will be done. At the same time such meetings provide an opportunity for exchange of views between those concerned with the maintenance of the lighting arrangements, and should be helpful in evolving a larger number of properly qualified experts who may fitly be termed "public lighting engineers." We look forward to the time when every city of importance will employ a fully qualified expert for these duties.

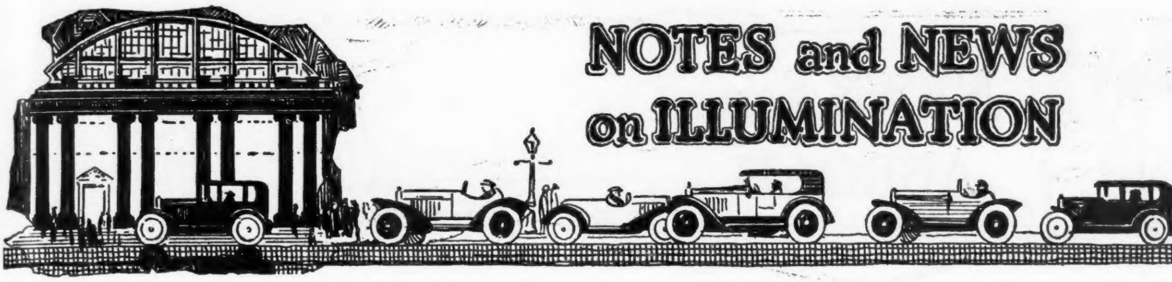
But in the long run it is on the views of the ratepayers that advances in public lighting depend. At present authorities, even if personally convinced of the importance of good lighting, are apt to be dominated by fear of increasing the rate. In many cases the conversion of obsolete lighting appliances and the substitution of up-to-date illuminants can not merely furnish better lighting, but bring about a saving. In Newcastle, we understand, substantial savings have thus been made. Improvements in public lighting, therefore, do not necessarily mean greater running expenditure. But, even so, the authorities and the ratepayers should understand that the cost of public lighting forms a very small item in the total expenditure of a city. Thus, in the paper presented by Dr. J. S. Thomas, it was pointed out that, even in the City of London (where the public lighting is admittedly exceptionally good), the rate for public lighting was only one-fourth of the police rate, and in other London boroughs mentioned by him the average lighting rate was only 1·62d. The public would, we feel confident, acquiesce in the necessary expenditure if they appreciated the resultant benefits of good lighting—especially as an element in street safety. It is now many years since we first urged the need for a proper analysis of the causes of fatal accidents in the streets. The problem has become of such gravity that such an inquiry is fully justified. It would, we believe, show that inadequate and unscientific lighting is a very important factor in the causation of accidents occurring by night. It is strange that, even by those directly associated with illumination, the available statistics relating to accidents occurring respectively "by day" and "by night" are sometimes misunderstood. Apart from some uncertainty arising from the definition of the day and night periods, it is obvious that in any circumstances the actual number of accidents occurring by day must be much greater than those occurring at night, when there is so much less traffic, and many fewer people in the streets. But, bearing in mind these factors, an examination of results shows that the number of night accidents is disproportionately large. There is already a considerable amount of evidence to show that unsatisfactory lighting is one of the causes of this disparity.

A comprehensive inquiry into the causation of street accidents would, we feel confident, leave no doubt as to the importance of public lighting. Such data would bring conviction to the public mind, and authorities would rightly be held responsible for accidents which occurred in their districts due to inadequate and unscientific methods of lighting. This is one of the chief methods of influencing public opinion. But, in addition, the inhabitants of a city should be brought to feel a pride in their lighting arrangements—to realize that their city is not attractive and does not appeal to visitors unless lighting conditions at once dignified and efficient are provided. In cities abroad public interest in the lighting question has been kindled by public meetings, by the dissemination of literature, and by the free demonstration of what modern methods of illumination can achieve. When the lighting of one city has been remodelled it serves as an example to others; thus propaganda has a far-reaching effect.

Another aspect of public lighting, which has begun to attract much more attention recently owing to the development of long-distance motor traffic, is the lighting of rural areas, and especially of arterial roads. Mr. Lennox, in his paper on this subject, pointed out that lighting of the highways is now the only public necessity left in the hands of the local parish council and provided solely by "local" rates. Roadways, sewerage and watching are provided out of the compound rates of the whole rural or county area. In the United States legislation has recently been passed removing this anomaly. In this country, we feel convinced, the tendency will be for the lighting of highways gradually to cease being a purely parochial affair. The necessity for special road surfaces for motor traffic has already led to the formation of the Road Board. With the growing development of night traffic the lighting of these surfaces has become as important as their upkeep. Illumination will demand similar supervision by a central and thoroughly representative authority.

In this connection the need for a generally accepted standard specification for street lighting is evident. After the 12 years which have elapsed the moment might be opportune for a revision of the draft standard specification based on the work of the joint committee representing the Illuminating Engineering Society, the Institutions of Gas and Electrical Engineers, and the Institution of Municipal and County Engineers, presented by Mr. Trotter before the Illuminating Engineering Society in 1913. The Illuminating Engineering Society, which was largely instrumental in bringing together the various bodies associated with this piece of work, would gladly co-operate in a resumption of this investigation, in which the special street lighting committee of the B.E.S.A. should participate.

Meantime we watch with sympathy the efforts of the Institution of Public Lighting Engineers to bring about a better appreciation of the essentials of good street lighting. In this work they are doubtless benefiting from the experience of Mr. Langlands, their first President, and Capt. W. J. Liberty, their Hon. Secretary, both of whom have been associated members of the Illuminating Engineering Society for many years.



Light Treatment and Night Workers

Dr. C. W. Saleeby, who writes to us from Vevey (Switzerland) where he is taking part in international conferences, draws attention to one important aspect of the use of artificial light as an aid to health, discussed in our July issue. He suggests that, in order to preserve their health, night workers should have regular artificial light baths. The case of people whose nights are devoted to work and their days necessarily mainly to sleep certainly deserves consideration, as they have little opportunity of enjoying the benefit of the sun's rays, to which Dr. Saleeby attached such importance in his lecture. This, no doubt, is one of those instances where "artificial daylight" can play a useful part as a substitute for the missing daylight.

Sunlight as a "Brain Food"

Another aspect of the value of sunlight is suggested by Sir Henry Gauvain's recent address at the Congress of the Royal Institute of Public Health. Hitherto attention has been concentrated mainly on its effect on the human body. But it is probable that its stimulating effect on the mind and spirits is at least equally important. In a sense, its action in this respect is analogous to the effect of vitamins in food-products. Experiments on children at the Alton Hospital are quoted as confirming the profound effect of sunlight on the spirits and mental activity of the patients, enabling them to make much better use of the educational facilities provided. One can well believe that this effect is not limited to natural lighting; it has often been remarked that people in a factory work better and more cheerfully when abundant artificial lighting is provided, and the psychological influence of good lighting on customers in shops has frequently been pointed out.

Motor Headlights: Is Switching Off Desirable?

In a contribution to *The Westminster Gazette*, Mr. J. Owen contends that the recommendation attributed to the R.A.C. that motorists should not switch off their headlights when approaching and passing other vehicles is incorrect. "The view taken by the R.A.C.," he says, "is that switching off adds to the inconvenience and dangers of driving at night, and that it is the lesser of two evils. This is not my experience. It is diametrically opposed to the views of all the leading experts on illumination, who are against sudden and violent changes of artificial light.

"Uniformity is what they recommend when and wherever possible, since nothing could be more harmful than to drive a vehicle from a brightly lighted street into a poorly lighted one, and vice versa.

"But when uniformity cannot be maintained they advocate that the lighting of all thoroughfares should be scientifically graded. Now, if that is essential in large towns, how much more so is it on dark, lampless country roads, which are flooded with the penetrating beams of headlamps, against which it is difficult to make headway.

"Strictly speaking it is the roads, not the vehicles, that ought to be lighted, but because that cannot be done at present—it will be in the future—it is the duty of every motorist to have a regard for his own and other people's safety by making as little use of his headlamps as possible, and when he does use them to make a regular practice of switching them off when approaching other vehicles."

White Lines at Dangerous Corners

The method of defining the course of vehicles at dangerous corners by means of a white dividing line is now being widely adopted and seems to be generally regarded as a useful step. The chief difficulty is that lines stencilled in white material rapidly become obliterated and have to be frequently renewed. Some more permanent method is needed. Inlays of white material, it has been suggested, could be inserted into the road surface, or, in the case of new roads, could form part of the actual road construction, as, for instance, a row of white granite sets embedded in a tar macadam way.

We understand that the Ministry of Transport has addressed a letter to the local authorities of Greater London suggesting an early conference on the subject.

Illuminated Direction Signs on the Underground Railways

The use of illuminated direction-signs on the Underground Railways has proceeded so continuously that new developments are constantly taking place. Those responsible deserve the gratitude of the public for the very complete way in which this method of conveying information to passengers has been adopted, and one is constantly noting new devices. One recent development is the method of notifying passengers regarding the destination of the next train some time before they have actually arrived on the platform. Thus the changing sign indicating whether the next train is to be a "Highgate" or "Hampstead" one, placed in the long passage connecting from the Bakerloo to the Charing Cross-Hampstead-Highgate Tube gives an early intimation when hastening one's steps is likely to be profitable. There is now a similar sign mid-way along the passage connecting the two platforms of Camden Park Station. By the way, one is inclined to wonder when the method of lighting of carriages on the old Highgate to Charing Cross route is going to be brought up to the high standard allowed to the newer carriages on the newer route to the City and South London. Habitual travellers to the West End view with some envy the up-to-date lighting conditions (comprising the use of diffusing-glass reflectors instead of bare lamps) enjoyed by travellers to King's Cross onwards—even though this affords a convenient means of distinguishing the two classes of trains!

A "Placard Clock" at Waterloo Station

We notice at Waterloo Station another novelty, which may be described as an illuminated placard clock. In a prominent position in the concours there is a box-like side containing two series of placards side by side, one carrying the figure of the hour, the other the minutes. This is synchronized with a clock, and the placards fall over at regular intervals, so that the two always show the exact time. The reverse sides of the placards are utilized for advertisements. The box is brightly lighted and the bold figures can be clearly distinguished from a considerable distance.

The Röntgen Society

We have received a list of the officers and Council of the Röntgen Society. The president for the new session is Mr. F. W. Aston; Mr. Geoffrey Pearce is Hon. Treasurer and Messrs. E. A. Owen and Russel J. Reynolds share the secretarial duties. Mr. G. W. C. Kaye is Hon. Editor, and the Council is of a representative nature.

Illuminating Engineering Society in Germany

Forthcoming Annual Meeting

The annual meeting of the Illuminating Engineering Society in Germany will be held during October 2nd-3rd at Munich. As mentioned previously, an opportunity will be afforded of visiting the Munich Museum, where an interesting series of exhibits of historic lamps and lighting appliances exists. Papers announced include: "The Art of Illumination," by P. Heyck; "The Present Position in Electric Street Lighting," by W. Wissmann; "Developments in Public Lighting in Munich," by C. Zell; "Further Progress in Public Electric Lighting in Berlin," by R. Mylo; and "The Present Position of Public Lighting," by Dr. W. Bertelsmann.

It is evident, therefore, that the proceedings will deal mainly with public lighting. Various reports of committees will also be presented.

A Course of Lectures on Illumination in Berlin

We have often recommended the co-operation of electric supply undertakings with lamp makers in propaganda work. A good instance of such co-operation is furnished by the series of lectures arranged by the Berliner Stadtischen Elektricitätswerken Aktiengesellschaft, with the aid of the Osram Licht-Gesellschaft, m.b.H., particulars of which are given in *Licht und Lamp*. These lectures are intended specially for electrical contractors and members of firms concerned with lighting, and there is no charge for admission. The course is taking place in the Bewag lecture hall, and is supplemented by demonstrations. The subjects of the lectures are as follows:—

Sept. 15th—"Characteristics of Good Illumination."

Sept. 18th—"Fundamental Principles of Illuminating Engineering and Measurements."

Sept. 22nd—"Various Types of Lamps and their Technical Applications."

Sept. 25th—"Reflectors, their Value and Practical Applications."

Sept. 29th—"Show-window Lighting."

Oct. 2nd—"The Lighting of Offices and Stores and Spectacular Lighting."

Oct. 6th—"Lighting of Factories and Streets."

Airway Lighting

According to *The Electrical World*, the most powerful beacon for airway lighting is that recently mounted in a high position at Dijon, France. This is credited with one billion candle-power, and is intended to guide pilots on the night-flying line connecting Paris and Marseilles. In the United States the marking out of flying routes by beacons is also making rapid progress. There are stated to be lights of half a billion candle-power at the Chicago, Iowa City, Omaha, North Platte, and Cheyenne landing grounds. These beacons serve a dual purpose. Their light is exposed as a means of identification, but when an aeroplane is approaching the earth the upward beam is turned off, and the area landing is then floodlighted. To mark out the route for night flying extending for a thousand miles west of Chicago there are five million candle-power beacons every 25 miles; these also serve to indicate the position of emergency landing grounds. The New York to Chicago airway now being put into commission has electric beacons every 12 to 17 miles apart. These lights are operated on a schedule. When a plane arrives at one of the regular landing fields the electric beacons behind it are turned off and the signal is sent out to light those in front of it. Thus when the aeroplane is in the air the pilot can always see his route ahead.

Papers on Electrical Engineering from Japan

From the Institute of Electrical Engineers of Japan we receive copies of several papers dealing with electrical engineering researches. The point that impresses us is these papers, which are reprinted from the Journal of the Institute, are in English. May we hope that the Illuminating Engineering Society in Japan will adopt the same excellent principle?

Illumination in Darkest Africa

According to accounts received, "darkest Africa" is not so dark as it used to be. Developments are proceeding slowly, but surely, in many vast wild areas. Indeed, if Stanley could to-day repeat his famous journey through the African jungle he would find electric lighting installed in some of the villages—and by waiting a few months he would be able to make part of the journey on the 200-mile electric railway now being built into the heart of the Belgian Congo!

The Course on Illuminating Engineering at The Polytechnic (Regent St.)

Readers will recall, in our last issue, the announcement on the special course on Illuminating Engineering, which is being included in the curriculum this season. The course comprises lectures and laboratory work for both first year and second year students, and enrolments are now being received.

Special interest attaches to the series of lectures (in the second year section of the course) on Illuminating Engineering, which are to take place on Wednesday evenings at 6-30 p.m. We understand that the first lecture, by Mr. S. T. Short, on September 30th, will deal with fundamental ideas in illumination, including the study of intensity, wavelength and colour, which will lead to a consideration of the eye and its power of adaptation to varying intensities of light.

The fee for the session is only 30s., and it should prove popular with students anxious to gain knowledge of this important subject. Full particulars may be obtained on application to The Polytechnic, 307-11, Regent Street, London, W. 1.

TECHNICAL SECTION
COMPRISING
Transactions of The Illuminating Engineering Society and Special Articles

The Illuminating Engineering Society is not, as a body, responsible for the opinions expressed by individual authors or speakers.

A New Form of Universal Portable Photometer

Based on a Modification of the Method of Lord Rayleigh

By Professor ANDRÉ BLONDEL

(Hon. Member of the Illuminating Engineering Society and the Institution of Electrical Engineers; Joint Director of the Service des Phares Francais, Member of the Academie des Sciences, etc.)

THIS new portable photometer originated from the design of a "lux-meter" described by me in 1912,* but has a much wider range of application, especially in connection with scientific research.

(a) The comparison-source (which was formerly a rectilinear incandescent filament) is in this case a surface of 18 mm. square and of uniform brightness, which can be controlled by means of a diaphragm placed in front of it and so arrranged as to enable the illumination to be varied from 0 to 400 lux. It consists of an opalescent glass placed in front of a cylindical enclosure, the interior of which is painted dead white. The back end of the cylinder carries a small incandescent lamp (of a special type yielding 2 or 3 c.p., and supplied with current by a dry cell or accumulator). It is itself movable within the cylinder, and its position can be adjusted by means of a rack and pinion. By this means one can so adjust the position of the lamp that the illumination registered is a convenient round figure.†

The diaphragm is one of the Blondel iris type‡, formed by two vanes with vertical edges, which may be displaced in front of a rectangular aperture. By utilizing supplementary plates of varying height one can also avoid the necessity of using dark glasses in order to diminish the light.

(b) The apparatus readily lends itself to the measurement of light yielded by sources at a considerable distance, and for this purpose is based on the method of Lord Rayleigh, modified in the manner described below, the eye being placed at the conjugate focus of a lens directed towards the source to be measured.

The lens then appears to the eye as a uniformly illuminated surface, the apparent brightness of which is a function of the illumination: this brightness is compared with that derived from a comparison "point

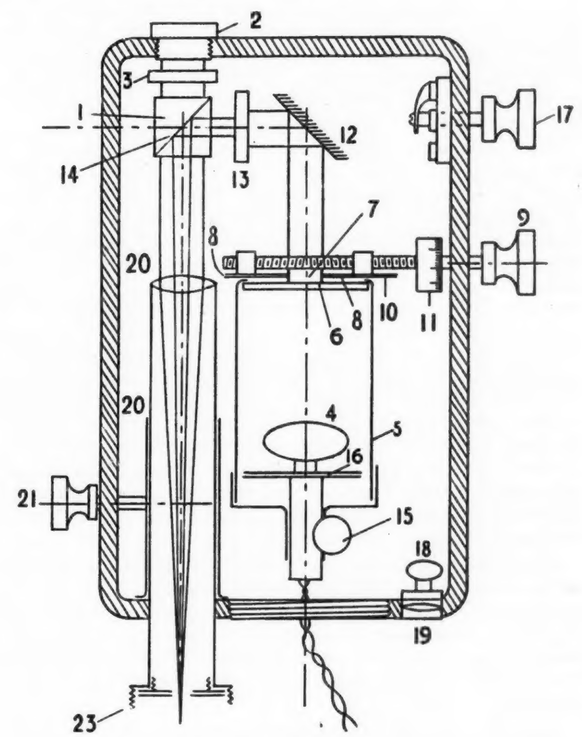


FIG. 1.

1 Lummer-Brodhun prism, with silvered band for the comparison of illuminations.
2 Cap of opal glass illuminated by the source or the surface which it is desired to examine.
3 Absorbing glasses transmitting 1-10th, 1-100th or 1-1,000th of the light examined.
4 Lamp serving as comparison standard.
5 Cylindrical enclosure coated internally a dead white.
6 Opal glass uniformly illuminated.
7 Rectangular aperture, the area of which is adjusted by means of the vanes 8.
8 Vanes, the displacement of which is controlled by the milled head 9.
9 Milled head for adjusting vanes 8.
10 Graduations indicating the number of turns of the head 9 proportional to displacement of vanes.
11 Drum graduated in hundredths of turns, and enabling the reading of graduation 10 to be completed.
12 45° mirror.
13 Ground glass.
14 Silvered band, the illumination of which is proportional to the opening between the vanes 8.
15 Rack and pinion controlling the movements of the lamp 4 as a basis for the selection of a convenient constant of calibration.
16 Movable disc, painted dead white, and enabling the volume of the enclosure 5 to be varied by 15.
17 Three-way switch, with dead position, for the lighting up of lamps 4 or 18.
18 Lamp for the illumination of graduations 10 and 11.
19 Lens to assist in the reading of graduations.
20 Telescope for the observation of prism 1.
21 Rack and pinion adjustment of telescope 20.
22 Objective lens of telescope 20.
23 Adjustable diaphragm.

* Revue *Science et Art de l'Eclairage,* II. Paris, 1902, and patents in various countries.

† In practice the apparatus is disengaged from accessories, such as the amperemeter, rheostat, etc., which are placed in a case containing also the accumulators; in this way the actual dimensions of the photometer may be reduced. The new model has been developed from my designs by Messrs. Delagrange (Clamart, Seine).

‡ Described at the Congress of the *Association Francaise* at Carthage in 1896.

source." In order to use, as in the luxmeter, a uniformly illuminated surface as the comparison-source, I have found it necessary to modify Lord Rayleigh's method by placing in front of the eye and at the focus of the telescope an artificial pupil 3-4 mm. in diameter, thus limiting to a constant aperture the rays coming from the comparison-surface which enter the eye. As a result the amount of light received from a source at a great distance is concentrated in a point at the centre of the pupil, and variations in the size of the pupil-aperture do not affect the apparent illumination of the comparison-surface.*

The accompanying illustrations and the subscript explain sufficiently well the construction of the apparatus. They show the essential parts of the instrument. An elbow tube, substituted in place of a cap, but carrying the cap at its free end, enables the illumination of a surface at any inclination to be measured, and in particular the illumination received by the cap when this is horizontal. Or one may remove the cap and substitute a test-surface of white diffusing material, which may be placed on a table or on the ground.

An auxiliary inspection tube also enables one to ensure correct relations between the focal distance and the position of the pupil of the eye. The assembly of the objective lens and the eyepiece thus mounted forms a terrestrial telescope. This enables the axis of the objective to be directed on the source to be studied, and its brightness examined according to the Rayleigh-Blondel method or measurements of the illumination of a surface to be undertaken. Correct inclination may be secured by a ball-and-socket joint either at the base of the instrument or, preferably, under the telescope.

(c) I have also added a microphotometric objective of low magnifying power (f = 25 to 35 mm.) which renders possible the measurement of the brightness of surfaces. The surface to be studied is placed at the focus of this objective, which plays the part of a collimator, illuminating the objective of the telescope. The diameter selected for the microphotometric objective is large enough (6 to 8 mm.) to give a convenient comparison surface in the plane of the silvered band. It is necessary that the image of the surface formed in the plane of the aperture of the artificial pupil should be large enough to cover all this luminous area. The magnification of the image in relation to the diameter of the surface studied is equal to the ratio of the focal lengths f and F of the two objectives. With F = 120 mm. and f = 30 mm. the magnification is 4 and the artificial pupil is 4 mm. in diameter. For smaller surfaces one would use a microscopic objective of shorter focus.

Once one has viewed correctly the surface to be studied by means of the eyepiece, as is indicated above, one observes the silvered band at the centre of a small luminous disc having a diameter equal to that of the microscopic objective, and one effects equality of brightness in the ordinary way by adjustment of the iris diaphragm.

(d) The arrangement for the measurement of brightness also enables the coefficient of absorption of optical apparatus to be determined in the following manner. One directs the instrument towards a white diffusing screen, uniformly illuminated, and places the photometer in front of the eyepiece of this instrument. One thus

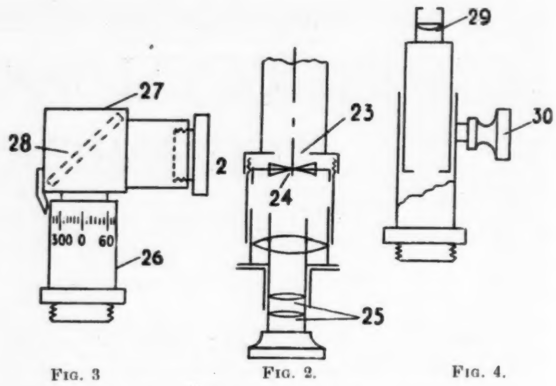


FIG. 3 FIG. 2. FIG. 4.

FIG. 2.—Arrangement of Eyepiece.

23 Diaphragm.

24 Reticule of telescope.

25 Adjustable two-lens eyepiece.

FIG. 3.—Arrangements for Reading Instrument.

26 Drum graduated from 0° to 360°, by the movement of which the illumination is recorded.

27 Tube movable about the axis of the cylindrical drum 26 and carrying a 45° mirror 28, and the cap 2.

28 45° mirror.

FIG. 4.—Microscope objective, which may be substituted instead of the cap 2.

29 Objective lens.

30 Rack and pinion adjustment.

measures the apparent brightness of the object thus seen. Next one lifts the telescope, and without touching anything one makes a second measurement, which gives the actual brightness of the white surface. The ratio between these two measurements gives the coefficient of transmission of the optical train, i.e., its photometric efficiency.†

(e) One may also use the photometer as a pyrometer, according to the Chatelier method, by interposing between the eye and the eyepiece a plate of red glass and introducing a suitable number of calibrated absorbing glasses to diminish the brightness of rays emitted by the surface examined.

In all these applications the measurements are made, according to circumstances, either by reference to a standard source or a surface receiving a known illumination and having a known brightness. This comparison may conveniently be made in the laboratory, and applied in the form of a calibration constant for the instrument. Such calibration constants may be determined in the laboratory for any operations to which the instrument may be applied.

The new portable photometer is thus a precision instrument which should have many applications in photometric laboratories, and it is of simple construction and inexpensive to manufacture. It has already found numerous applications in the Laboratoire Central d'Electricite de Paris, the marine laboratory at Toulon, the Nancy University, and in several industrial research laboratories of importance.

Spectacles for Colour Matching

A somewhat novel method of dealing with the problem of colour matching has recently been announced. Hitherto, in judging colours by artificial light, the correction has been applied to the illuminant. Thus, by the aid of suitable screens and filters we convert the light from a gasfilled lamp into "artificial daylight." According to *The Electrical World* attempts are now being made to deal with the problem in a different and somewhat simpler way, i.e., by applying the correction to the eye instead of to the illuminant. To Dr. Hermann Weiss, of Vienna, is ascribed the invention of "daylight spectacles." These spectacles are furnished with special blue glass which removes the excess of yellow present in most artificial illuminants, so that an object viewed through them appears as though illuminated by daylight.

* The method adopted in the present apparatus differs, as is desired, completely from that employed in the recently described and ingenious photometer of MM. Frabry and Buisson. In the latter apparatus, also founded on Lord Rayleigh's method, one compares the distant source with an auxiliary point source, the rays of which are conveyed by a second objective having the same focal length as the first, the illumination being adjusted by means of a double wedge of dark glass. My apparatus allows one to avoid the use of absorbing screens, which are never quite neutral. However, dark glasses calibrated to diminish the light to a tenth, a hundredth, or a thousandth, may be interposed in the path of the rays from the distant source if desired, though it is much better to replace them by a Masson-Talbot rotating disc, having a sector opening adjustable according to the diminution in light it is desired to secure.

† This method of measurement satisfies exactly the requirements recently formulated by the special committee formed by the *Institut d'Optique* for the determination of conditions of transmission by optical apparatus.

Notes for the Photometric Laboratory

III. The Calculation of the Total Transmission Factors of Coloured Filters

by

H. BUCKLEY AND F. J. C. BROOKES

(From The National Physical Laboratory)

THE experimental determination of the total transmission factors of coloured filters is in general a very difficult matter, owing to the difficulties involved in making brightness comparisons with lights of different colour. These difficulties are in part experimental and in part fundamental to all photometric measurements in which colour differences are involved.

The experimental difficulty is that of obtaining consistent brightness matches, and may largely be overcome by the use of the flicker photometer. The fundamental difficulty is that there is usually no certainty that such results as are obtained represent what would be obtained by "the average eye," in terms of which the results should be given if they are to have any value. The uncertainty in the results may, however, be reduced by the employment of a number of observers.

In these circumstances it is very often preferable to calculate total transmission factors from a knowledge of the transmission of the filters at various wave-lengths throughout the spectrum. The following notes describe a method which has been adopted at the National Physical Laboratory for determining the total transmission ratios of coloured glasses for signal lights, daylight glasses and various photometric filters.

The total light transmitted by a colour filter is given by

$$T = \frac{\int_{0\cdot 40\mu}^{0\cdot 76\mu} \alpha_\lambda E_\lambda V_\lambda d\lambda}{\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda}$$

where α_λ = transmission factor of filter at wave-length.
E_λ = relative energy in light source at wave-length.
V_λ = relative visibility at wave-length.

The numerator of the above expression is proportional to the quantity of light transmitted by the filter, and the denominator is proportional to the light emitted by the source. For $\alpha_\lambda E_\lambda V_\lambda d\lambda$ and $E_\lambda V_\lambda d\lambda$ are each proportional to the light in a wave-length interval $d\lambda$ at wave-length λ for the transmitted light and the light from the source respectively, while the integral signs merely state that the sum of all these quantities has to be taken for all values of λ between $\lambda = 0\cdot 40\mu$ and $\lambda = 0\cdot 76\mu$, these being the limits of the visible spectrum for all practical purposes.

The transmission factor of a coloured filter depends upon the source with which it is used, owing to the different proportions of light of various wave-lengths in different sources. Thus, for each type of source there will result a different value for the denominator of the fraction giving the transmission factor of the filter. Since E_λ is definite for each kind of source, and V_λ is a constant for each wave-length, it is possible to prepare a table of values of the product $(E_\lambda V_\lambda)$ for each type of source, such that $\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda$ has the value unity.

The determination of a total transmission factor can, therefore, be reduced to the determination of the value of $\int_{0\cdot 40\mu}^{0\cdot 76\mu} \alpha_\lambda (E_\lambda V_\lambda) d\lambda$ using the value of the product $(E_\lambda V_\lambda)$ appropriate to the kind of source.

If α_λ is expressed as a fraction (less than unity), the result will give the value of the total transmission as a fraction (less than unity), whereas if α_λ is expressed as a percentage, the value of the total transmission will also be given as a percentage.

Since most incandescent sources can be colour matched with the radiation from black bodies or Planckian radiators at definite temperatures, and consequently their energy distributions throughout the visible portion of the spectrum are similar to those of the black bodies at these temperatures, the values of the products $(E_\lambda V_\lambda)$ have been determined for radiation corresponding to a number of temperatures as well as for the radiation from a Welsbach mantle, and average blue sky. (The temperature of a black body at which its radiation colour matches that from a light source is called the "colour temperature" of the light source.)

In order to obtain the values of $(E_\lambda V_\lambda)$ such that $\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda = 1$ the value of this integral was determined by means of Simpson's rule with 37 ordinates, and the separate products $E_\lambda V_\lambda$ multiplied by

$$\frac{1}{\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda}$$

$$\text{Thus} \int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda \left\{ \frac{1}{\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda} \right\} d\lambda$$

$$= \frac{1}{\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda} \int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda = 1.$$

The results of such computations are given in the accompanying table. The value of E_λ used were those calculated by Forsythe* from Wien's equation

$$E_\lambda = k\lambda^{-5} e^{-C_2/\lambda T}$$

which gives results practically identical with those given by Planck's more complicated formula, except for the temperature 5000° K. For this temperature Planck's formula was used, but the difference between the two formulæ is still very small even at this high temperature. The values of V_λ used were those recommended for international adoption at the Geneva meeting of the International Commission on Illumination, July, 1924,† as a result of the work of Gibson and Tyndall. They were recommended for general use, with a proviso that for special cases dealing particularly with the ends of the spectrum, or with special conditions of field size and intensity, they should be used with caution.

The numerator $\int_{\cdot 040\mu}^{0\cdot 76\mu} \alpha_\lambda (E_\lambda V_\lambda) d\lambda$ is most conveniently evaluated by Simpson's rule, using values of the extreme wave-lengths suitable to the particular filter whose transmission is being determined, so that an odd number of ordinates are used. The ordinates are most conveniently those at every $0\cdot 01\mu$ or every $0\cdot 02\mu$.

Simpson's rule then gives

$$T = \int_a^b \alpha_\lambda (E_\lambda V_\lambda) d\lambda = (A + 2B + 4C)\, x/3$$

where a and b are the extreme wave-lengths transmitted

*Forsythe, *J. Opt. Soc. Am. Vol IV. p.* 331 (1920).

† Proceedings of the Sixth Session of the International Commission on Illumination (in the press); also *Gas Journal, Vol.* 169, p. 219 (1925).

by the filter at which ($E_\lambda V_\lambda$) has appreciable values and A = sum of first and last ordinates
B = sum of remaining odd ordinates
C = sum of even ordinates
x = distance apart of ordinates.

As an example, the total transmission of the glass whose spectral transmission is illustrated in Fig. 1 is worked out below for the case in which it is used with a source whose relative spectral energy distribution is the same as that of a black body at 2,000° K., i.e., whose colour temperature is 2,000°K.

Wave-length λ	% Transmission a_λ	Product ($E_\lambda V_\lambda$)	Product $a_\lambda(E_\lambda V_\lambda)$		
0·45	40·0	0·042	1·68	—	—
0·46	43·7	0·083	—	—	5·26
0·47	46·6	0·158	—	7·36	—
0·48	49·1	0·299	—	—	14·67
0·49	50·6	0·548	—	27·72	—
0·50	49·2	1·029	—	—	50·60
0·51	47·5	1·923	—	91·40	—
0·52	43·4	3·227	—	—	140·00
0·53	38·3	4·622	—	177·00	—
0·54	32·2	5·986	—	—	192·80
0·55	25·8	7·248	—	186·90	—
0·56	19·4	8·366	—	—	162·20
0·57	14·2	9·172	—	130·20	—
0·58	10·0	9·549	—	—	95·49
0·59	6·8	9·407	—	63·95	—
0·60	4·5	8·829	—	—	39·71
0·61	2·85	7·883	—	22·48	—
0·62	1·85	6·654	—	—	12·32
0·63	1·15	5·134	5·90	—	—
			7·58 A	707·01 B	713·04 C

The limits of transmission giving appreciable values of ($E_\lambda V_\lambda$) are 0·45μ and 0·63μ, which with a spacing of 0·01μ give 19 ordinates from which to calculate the transmission.

$$A = 7{\cdot}58 \qquad\qquad x = 0{\cdot}01$$
$$2B = 1414{\cdot}02$$
$$4C = 2852{\cdot}16$$
$$A + 2B + 4C = 4273{\cdot}76$$

$$\therefore \text{Total transmission} = (A + 2B + 4C)\,x/3$$
$$= \frac{4273{\cdot}76 \times 0{\cdot}01}{3}$$
$$= 14{\cdot}25 \text{ per cent.}$$

The selection of the appropriate values of ($E_\lambda V_\lambda$) to use in any case depends on the energy distribution of the source which is being used. Data are available on the colour temperature of various sources,* and the set of values of ($E_\lambda V_\lambda$) for the temperature closest to the colour temperature should be taken. For more accurate work it is sufficient to determine the transmission for temperatures on each side of the colour temperature of the source, and deduce the required result by linear interpolation.

SPECTRAL TRANSMISSION CURVE OF GREEN SIGNAL GLASS.

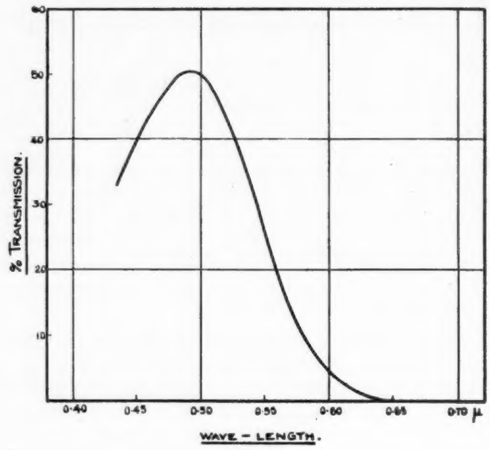


FIG. 1.

VARIATION OF TOTAL TRANSMISSION WITH TEMPERATURE OF SOURCE OF GREEN SIGNAL GLASS IN FIG. 1.

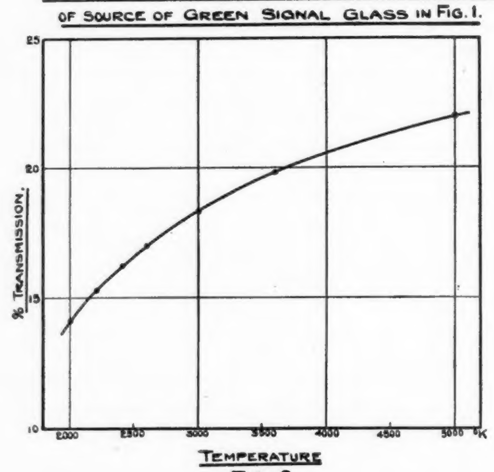


FIG. 2.

Fig. 2 shows how the total transmission of the filter, whose characteristics are given in Fig. 1, varies with the temperature of the source.

* Cady and Dates, *Illuminating Engineering*, p. 38.

The Utilization of Research

In a recent note in *The Engineer* there is an able summary of the possibilities of research. This country, many years ago, attained a prominent position in original research and discovery. But before new discoveries can be applied in practice they must be "worked out" much further than the pioneer investigators are usually able to carry them, and there is a great deal of spade work to be done before their practical benefit is realized. It is in this field, *The Engineer* remarks, that workers in this country have been less successful. Even when the subject has been completely studied in the laboratory, industrial application cannot follow immediately. The step from the laboratory to the works is too large to be taken in a single stride, and some form of intermediate organization is essential. This may be termed the "experimental plant" stage, when mutual education on the part of the laboratory man and the works man takes place. In some cases it may even be necessary to establish a species of experimental factory to conduct this intermediate process—the new product being made on commercial lines, but in limited quantity, until all obstacles to mass production have been removed.

The dye industry has often been quoted as an instance of close co-operation between the experimenter and the works expert, and as an example of successful co-operation between science and industry. The manufacture of electric incandescent lamps is another case. It is well known that some of the largest and most successful works of this kind have not only established research laboratories and well-equipped technical libraries, but have also evolved experimental workshops where any new form of lamp can be made on a small scale until all imperfections in the process of manufacture disappear.

VALUES OF $(E_\lambda V_\lambda)$ AT VARIOUS TEMPERATURES TO GIVE $\int_{0\cdot 40\mu}^{0\cdot 76\mu} E_\lambda V_\lambda d\lambda = 1$

Wave-length	1800°K	2000°K	2200°K	2400°K	2600°K	3000°K	3600°K	5000°K*	Average Blue Sky	Gas Mantle	Wave-length
0·40μ	$\cdot 0000_6$	$\cdot 0001_1$	$\cdot 0001_8$	$\cdot 0002_7$	$\cdot 0003_8$	$\cdot 0006_6$	·0019	·0026	$\cdot 005_4$	$\cdot 0001_9$	0·40μ
·41	$\cdot 0002_5$	$\cdot 0004_4$	$\cdot 0007_0$	·0010	·0014	·0023	·0039	·0083	·017	$\cdot 0007_3$	·41
·42	·0012	·0020	·0030	·0043	·0058	·0091	·0149	·0289	·058	·0034	·42
·43	·0047	·0076	·0112	·0158	·0202	·03 7	·0479	·0872	·171	·014	·43
·44	·0127	·0196	·0280	·0375	·0477	·0698	·1045	·1794	·339	·036	·44
·45	·0281	·0416	·0574	·0749	·0930	·1313	·1891	·3064	·554	·083	·45
·46	·0584	·0832	·1113	·1415	·1718	·2341	·3237	·4980	·858	·168	·46
·47	·1150	·1580	·2049	·2541	·3020	·3977	·5302	·7748	1·265	·310	·47
·48	·2250	·2986	·3762	·4555	·5302	·6760	·8699	1·210	1·87	·575	·48
·49	·4263	·5480	·6701	·7927	·9054	1·095	1·391	1·846	2·65	·986	·49
·50	·8297	1·029	1·228	1·420	1·591	1·908	2·298	2·914	3·95	1·81	·50
·51	1·598	1·923	2·236	2·533	2·787	3·246	3·789	4·604	5·82	3·18	·51
·52	2·764	3·227	3·662	4·064	4·396	4·981	5·641	6·572	7·85	5·00	·52
·53	3·982	4·622	5·123	5·574	5·929	6·540	7·196	8·054	9·01	6·70	·53
·54	5·425	5·986	6·488	6·922	7·247	7·791	8·338	8·979	9·56	8·00	·54
·55	6·752	7·248	7·686	8·056	8·304	8·709	9·072	9·413	9·53	9·18	·55
·56	7·994	8·366	8·681	8·941	9·078	9·296	9·435	9·450	9·24	9·67	·56
·57	8·983	9·172	9·327	9·226	9·452	9·455	9·362	9·058	8·35	9·48	·57
·58	9·582	9·549	9·518	9·477	9·363	9·155	8·848	8·282	7·31	9·10	·58
·59	9·661	9·407	9·202	9·016	8·783	8·393	7·942	7·200	6·14	8·52	·59
·60	9·276	8·829	8·475	8·182	7·865	7·374	6·812	5·989	4·98	7·67	·60
·61	8·465	7·883	7·433	7·069	6·715	6·171	5·574	4·757	3·78	6·23	·61
·62	7·298	6·654	6·169	5·729	5·426	4·891	4·326	3·587	2·75	4·77	·62
·63	5·745	5·134	4·630	4·326	4·013	3·549	3·076	2·480	1·49	3·35	·63
·64	4·274	3·734	3·359	3·063	2·807	2·439	2·067	1·627	1·19	2·21	·64
·65	2·930	2·516	2·223	2·001	1·813	1·549	1·290	·9867	·709	1·34	·65
·66	1·863	1·571	1·367	1·215	1·089	·9164	·7478	·5577	·395	·771	·66
·67	1·086	·8993	·7709	·6768	·6005	·4958	·3983	·2899	·199	·405	·67
·68	·6381	·5193	·4389	·3807	·3345	·2717	·2144	·1524	·103	·215	·68
·69	·3391	·2714	·2261	·1951	·1687	·1349	·1077	·0727	·047	·102	·69
·70	·1861	·1465	·1204	·1021	·0880	·0693	·0529	·0359	$\cdot 022_5$	·051	·70
·71	·1042	·0808	·0655	·0549	·0467	·0364	·0274	·0182	$\cdot 011_5$	·026	·71
·72	·0568	·0433	·0347	·0288	·0244	·0187	·0138	·0090	$\cdot 005_8$	·013	·72
·73	·0306	·0230	·0182	·0149	·0125	·0094	·0069	·0044	$\cdot 002_8$	$\cdot 006_3$	·73
·74	·0159	·0118	·0092	·0075	·0062	·0046	·0033	·0021	$\cdot 001_3$	$\cdot 003_0$	·74
·75	·0082	·0060	·0047	·0037	·0031	·0023	·0016	$\cdot 0009_8$	$\cdot 000_6$	$\cdot 001_5$	·75
·76	·0044	·0032	·0024	·0019	·0016	·0012	·0010	$\cdot 0004_8$	$\cdot 000_3$	$\cdot 000_7$	·76

* Represents also average daylight and noon sunlight.

Motor Vehicle Headlights

A well-illustrated and useful circular on the above subject has been issued by the Bureau of Standards, Washington (No. 276). We hope to deal more fully with this in a subsequent issue, but meantime it may be noted that the work is largely the result of co-operation with the American Automobile Association, the motor-vehicle lighting committee of the American Illuminating Engineering Society, and the lighting division of the standards department, Society of Automobile Engineers.

In the United States headlights are attracting quite as much attention as in this country. It is stated that in 1924 there were 17,000,000 motor-vehicles in use, as compared with about 1,000,000 in 1912. The circular discusses the main requirements of safe night-driving, and illustrates many recent types of headlights, most of them based on the idea of restricting the beam below a specified horizontal plane. Other sections deal with the "spotlight," a helpful auxiliary equipment to the motor-car, and various "anti-glare" devices, most of which, however, seem to have proved of doubtful benefit in practice. It is to the scientific design of the headlight that we must chiefly look for improvement.

In conclusion, a summary is given of the laboratory tests to which a headlight is subjected in order to ensure compliance with requirements—though it is stated that the procedure adopted by various States differs considerably. The Bureau of Standards has, however, acted as the official testing agency for some State officials, and the account of the method followed at the Bureau in making laboratory tests should therefore prove useful.

Progress in the Use of Incandescent Lamps for Kinema Projectors*

By Dr. L. BLOCH

UP to the year 1913 the ordinary carbon arc was the only source that could be used for kinema projectors. But the introduction of the gasfilled lamp has altered the situation. Units of 50 c.p., on 6-8 volts, for projectors used in the home, and up to 1,000 watt for projectors used in schools, are now available.

Following the war a substantial advance was made in America by the construction of lamps in tubular form, composed of glass of high melting point. This enabled the lamp filament to be brought nearer the condenser, with a consequent increase in the percentage of the total light usefully employed. Moreover, by the use of lamps of low voltage the output of light and intrinsic brightness could both be materially improved. In Germany similar lamps of from 100 to 1,000-watt capacity were constructed in 1923, as soon as workers in this country had also been successful in producing suitable glass.

Simultaneously, however, a material improvement has been made by the substitution of a spherical mirror for the condenser hitherto employed with the arc. As a result, only one-third to one-fifth of the consumption formerly necessary in order to obtain a certain illumination on the screen was required. Hence a considerably higher screen brightness became possible than in the past. Owing to this advance in the requirements of kinema theatres the glowlamp projectors were confined to domestic use, applications in schools, or for travelling kinema displays. In America the chief recent development appears to have been the adoption of double and triple condensers. In Germany the mirror principle has also been applied to glowlamps, and at the same time a still further increase in candle-power and brightness of filaments has been secured. In judging lamps for projector-sources it is convenient to define the luminous surface as the entire area enclosed by the limits of the filament (including the area in between the spirals). On this basis one obtains the following values for the brightness (Hefner candles per square millimetre) of various 500 to 600-watt lamps:—

Type of Lamp.	Brightness (Hefner candles per sq. mm.)
Vacuum high c.p. lamp	0·1
Ordinary gasfilled lamp	0·6
Projection lamp, spherical form, 110 v.	3·8
,, ,, 30 v.	9·8
Kinema lamp, tubular form, 110 v.	7
,, ,, 30 v.	14
,, ,, 15 v.	42

The last figure shows very clearly the progress made in the brightness of filament attained in the recent tubular lamps; it is more than 400 times as great as for the original vacuum type high candle-power lamp.

The glass used for these kinema lamps has a melting point over 100° higher than that ordinarily used for lamps, but its coefficient of expansion is only half as great. For leading-in molybdenum wire 2 mm. in diameter is used. The filament consists only of a few turns of tungsten wire 0·7 mm. in diameter, and is supported by a strong anchorage of nickel wire. Lamps are furnished with Goliath holders for currents up to 40 amps. The latest type, giving a brightness of 42 candles per square millimetre, operates at 40 amps., 15 volts, is specially adapted for use in kinema theatres. The specific consumption of these lamps is about 0·3 watts per candle. The colour of the light is not materially different from that of the arc lamp, as a comparison of its red, green and blue components shows. The variation in candle-power with voltage is also less than is the case with glowlamps hitherto used. Candle-power varies approximately as the third power of the voltage and the fifth power of the current. Life is primarily determined by the current passing through the filament. The normal life may be assumed to be about 100 hours. By diminishing the current by 5 per cent. (say from 40 to 38 amps.) the life is multiplied 2·5 times. Careful control of the current is accordingly important, and such lamps are conveniently rated in terms of current instead of voltage. Current is conveniently obtained on alternating circuits from a small transformer; on direct-current circuits from a rotary converter. Current is regulated either by the transformer or by a small auxiliary resistance, an ammeter being included in the circuit.

A light and stationary holder is equipped with a parabolic mirror 200 mm. in diameter and of 75 mm. focus placed behind the lamp. The lamp can then be used either with a very simple form of auxiliary condenser or without any condenser at all. For the objective the usual type of lens 52 mm. in diameter may be used. It is to be noted that the temperature of the window where the film is situated is not higher than when an arc lamp of similar current consumption is used.

The chief criterion of performance of a kinema projector is the *efficiency*, i.e., the ratio between the flux of light usefully applied on the screen and the total flux of light emitted by the source. Whereas, with kinema projectors using tubular gasfilled lamps and condenser-lenses, the efficiency hitherto obtained was at best 2·5 per cent., with the new mirror-arrangement 6-7 per cent. is attained. Whilst the efficiency of the arc-projector system defined above has not yet been quite equalled, with the glowlamp it must be remembered that the tubular gasfilled lamp yields 32 lumens per watt as compared with 12 lumens per watt from the arc. Owing to this fact, the actual specific consumption in terms of light usefully applied on the screen, 2 lumens per watt, is materially better than the corresponding figure for the arc-lamp, which is only 1·5 lumens per watt.

This considerable advance in efficiency renders the tubular gasfilled lamp very suitable for small and medium-size kinema theatres, and in cases where only alternating current is available. Another advantage in this case is the high efficiency of the transformer (85 to 90 per cent), whereas with an arc lamp a rotary converter with an efficiency of not more than 70 per cent., and more frequently 50-60 per cent., is necessary. The use of arcs direct on an alternating current has admittedly proved unsatisfactory. The 40-amp. 600-watt tubular gasfilled lamp furnishes 1,100 to 1,300 lumens, to supply which a direct-current arc lamp taking 10 amps. and 750 watts would be necessary. Taking into account the difference in efficiency of transformers and rotary converters, the glowlamp requires 750 watts as compared with 1,500 watts for the arc. Even with direct current and a rotary converter the gasfilled lamp, with a consumption of 1,250 watts, is more economical than the arc lamp.

The price of one of these special kinema gasfilled lamps is about 25 marks. The cost of replacing lamps therefore naturally works out higher than maintenance costs in the case of the arc lamp. But this is compensated by the saving in running costs for energy. The 40-amp. 600-watt gasfilled lamp gives a useful flux of about 1,200 lumens; thus a picture of 5·5 m.m. broad can receive the usual illumination of about 50 lux. This form of lamp finds its best application in small and medium-sized theatres, where alternating current must be used; for travelling theatres the 110-volt lamp, in combination with a triple condenser and adjustable resistance, is most useful, since in this case one may have to take either direct current or alternating current, and the voltage available is very variable. It is, however, possible that the gasfilled lamp will also prove acceptable in theatres where direct current is used, for its conveniences are considerable. Amongst its chief advantages are simple maintenance and installation, absence of need for regulation to counteract fluctuations of light and absence of troublesome fumes. It may well be hoped that further experiment will result in lamps of still greater power and brightness, such as would prove acceptable in the larger theatres.

* Abstract of a paper read before the German Illuminating Engineering Society.

The Illumination of Factories*

By L. GASTER, F.J.I.

THE illumination of factories is a subject that has for a number of years been receiving an increased amount of attention in many countries, and has been dealt with at numerous international conferences. I may recall that before the war it was discussed in some detail at the International Congress on Industrial Hygiene held in Brussels in 1910 and at the First International Congress for the Prevention of Industrial Accidents at Milan in 1912. In the post-war period the study of the subject has been resumed by hygienists and illuminating engineers, whose co-operation is essential for a proper solution of the problem. In particular, reference should be made to the International Congress on Industrial Hygiene, held in Geneva in July last year, and at the meeting of the International Illumination Commission in the same city. Everywhere we find a recognition that good industrial lighting is essential in the interests of safety, health and efficiency.

By experts on hygiene it is now recognized that good lighting should be ranked with proper heating and ventilation and sanitation as essential to the health of the worker. At the congress in Geneva, referred to above, a special resolution was passed to this effect, emphasizing the need for continued co-operation between hygienists and lighting experts in this field. This view is likewise accepted by the International Labour Bureau of the League of Nations in Geneva, which has recently issued a comprehensive report surveying progress in various countries.

These remarks will serve to show that the subject has assumed international importance, and it is now proposed to mention some aspects of the subject of special interest to members of this Congress. The most direct effect of inadequate lighting is upon the eyesight of workers. Prof. G. Oblath, in a paper presented at the Congress in Geneva last year, mentioned this as one of the main causes of ocular fatigue, and he narrated experience amongst workers in Baden and elsewhere, showing how disorders of vision disappeared or were alleviated when the lighting was improved. Prof. Oblath also emphasized a point that has received attention from other experts—that a person should, in his own interests, be debarred from entering professions and trades making a specially severe tax on eyesight, if he suffers from visual defects likely to be accentuated by so doing. Dr. L. Carozzi, in dealing with the printing and other industries, has recommended the grading of industrial operations in terms of demands on vision and the systematic testing of the eyesight of workers in order to prevent progressive deterioration of vision. Whilst fuller evidence on the effects of inadequate lighting on sight are much to be desired—and the co-operation of hygienic and medical experts is here essential—there is a general recognition that inadequate lighting, by accentuating the strain of close vision, is liable to cause visual defects to become worse. It has also been observed, for example, in comprehensive tests undertaken by the United States Public Health Department on lighting conditions in post offices, that persons with subnormal vision are more affected by inadequate lighting than those with good sight. The improved efficiency and speed of work resulting from the introduction of better lighting conditions was most marked amongst classes of operators having a relatively low standard of vision. Industries have been studied in terms of the eyesight of workers. It has been found that defects of vision are most frequent in those trades, such as the printing and garment-making industries, which involve fine work and continuous close vision. In such cases good illumination is therefore particularly desirable.

Nevertheless, whilst the benefits of good lignting are generally recognized and evils of inadequate illumination are evident, we do need more detailed scientific information as to the effect of lighting conditions on vision. It has been sometimes suggested, for instance, that defective vision is to some extent hereditary, but is, nevertheless, accentuated by efforts to work under unsatisfactory lighting conditions. If this is so, it would appear that the effect of continuous work by poor illumination would be to cause a progressive accentuation of defective vision, which, unless corrected, would show still worse results in the case of the next generation. One would appreciate the help of oculists and the medical profession in dealing with this question, and in tracing, by actual records of the eyesight of workers, when the lighting conditions are liable to cause eye-strain and other ill-effects.

Another striking instance of the results of work by inadequate illumination is the disease known as "miners' nystagmus," which has been the subject of discussion at many Congresses. At a joint discussion of the Illuminating Engineering Society and the Royal Society of Medicine in London in 1920 the general opinion was expressed that the main cause of this disease is the very low illumination by which miners work. This conclusion has been confirmed by a special Committee appointed by the Medical Research Council, by the investigations of Dr. Strassen of Liège and others, and special efforts have recently been made to increase the candle-power of miners' lamps, and apply it more scientifically, with hopeful results.

But, apart from the direct effect of poor lighting on vision, its influence on general physical conditions is also of great importance. Tests conducted by the Industrial Fatigue Research Board, the National Institute of Industrial Psychology, and other bodies, have shown what a large part industrial fatigue plays in diminishing the efficiency of workers. Experiments have shown how work can be more accurately and expeditiously done, with much less strain to the workers, by arranging suitable periods for recuperation, and ensuring that effort is kept within the prejudicial limit. There can be no question but that inadequate lighting greatly increases the strain involved in many forms of close and careful work, and that by accentuating industrial fatigue it reacts unfavourably on the health of workers. Systematic tests in various industries, in which lighting experts, hygienists and statisticians should co-operate, are much to be desired.

Many problems could be mentioned to illustrate the need for such co-operation. We need, for instance, some easily applied test by which to recognize when fatigue appears, so that different systems of lighting may be compared in this respect. In the same way the recognition that the exposure to the eyes of bright sources which are "glaring" leads to fatigue and discomfort has led to the framing of various rules based on the limitation of the brightness of exposed sources, or assigning positions to them such that the lights do not fall within the direct range of vision. These rules, based on practical experience, help to eliminate sources of eyestrain. But the problem would be more simplified if, by the aid of physiologists, we could obtain some simple indication as to when a system of lighting is glaring or contrasts in brightness are excessive. Our rules would then be based on scientific evidence to a greater extent than at present. Equally important is the fundamental question of the amount of illumination needed for various kinds of work. Lighting experts are aware that this is not only a function of the nature of the operation, e.g., the amount of close effort required by the eye, but also depends on the nature of the material worked with (whether light or dark in texture), the contrast between the illuminated material, and the brightness of surroundings, etc. We need a scientific

* Abstract of a paper presented at the Fourth International Medical Congress of Industrial Accidents and Diseases, held in Amsterdam, September 7th-12th, 1925.

test to determine when the illumination is adequate for the purpose and ready means of recognizing signs of fatigue arising from insufficient light and measuring the benefit derived when the illumination is increased.

Yet another field—of special interest to the psychologist—is the influence of colour. Lighting experts in general recommend that walls and ceilings should have a light colour, in order that as much light as possible may be reflected and diffused by such surfaces. One has, however, a choice of many colours which reflect a relatively large proportion of light, and recent investigations have suggested that a "warm" tint, such as red or orange, has a stimulating effect which is favourable to energetic work. It has often been remarked that the red end of the spectrum is associated with mental activity and cheerfulness, whereas blues and greens have a sedative and restful effect. On such questions we need more detailed scientific information, but the matter is evidently one that deserves to be taken into consideration by the manager of a modern factory. Again, for most purposes, we find it desirable to have an illuminant which broadly resembles daylight in giving an approach to "white light." It has, however, been suggested that for certain operations monochromatic light is favourable to greater acuteness of vision. The whole question of the effect of colour in industrial operations is one that requires elucidation.

In studying all such problems, the aid of the physiologist, opthalmologist and hygienist is essential. A start has been made by the operations of the Committee on Illumination working under the Department for Scientific and Industrial Research, which includes amongst its members eminent physiologists and ophthalmologists, as well as experts on lighting. In the United States, under the National Research Council, similar researches are being initiated. What I would like to impress upon members of this Congress is that the illumination of factories is primarily a hygienic problem, and that interchange of views on these debatable matters by hygienic and lighting experts in all the chief countries is essential for its proper solution.

Meantime, whilst the scientific basis underlying recommendations on illumination is as yet incomplete, we have a considerable amount of information, based on practical experience in factories, illustrating how better lighting, by removing handicaps on the worker, leads to improvement in efficiency and output of work. Tests by the Industrial Fatigue Research Board have led to the conclusion that in the silk and cotton-weaving industries the average output by artificial light is 10-12 per cent. less than by good daylight, thus showing the close relation between conditions of illumination and efficiency and the need for improvement in the artificial lighting at present provided, so that the conditions characteristic of the best daylight may be more closely approached. In addition, the question of access of daylight into buildings deserves attention, in view of its general relation to health and the fact that the greater proportion of working hours is still undertaken by natural light.

Consideration of the close relation between illumination and health, safety and efficiency, led the Home Office in England to appoint a Departmental Committee on Lighting in factories and workshops in 1912. This Committee continued its work during the war, and has issued three comprehensive reports, summarizing the principles of good illumination and making definite recommendations, which it is hoped will be embodied in the Factory Acts in the near future. Minimum values of illumination requisite in the interests of safety have been prescribed, and recommendations made on methods of avoiding glare from unshaded bright sources, inconvenient shadows, flicker, etc. As an indication of good practice the Committee suggested minimum values of 3 foot-candles for fine work and 5 foot-candles for very fine work; but it is not proposed to adopt these as legal minima, and it is recommended that the requirements of various processes should be determined by consultation and research with the industries concerned. Codes prescribing industrial lighting requirements have been adopted by a number of the United States of America, and in principle these agree with the recommendations of the British Home Office Departmental Committee. No doubt, in course of time, recommendations on industrial lighting will be issued in other countries, and it is hoped that intercourse being promoted between the experts of various nations will result in the acceptance of common principles as a basis for legislation. It is now recognized that the main principle of such legislation should be safeguarding of workers from conditions prejudicial to health and safety, that no undue hardship should be imposed, so that recommendations will be accepted by workers and employers alike as made in their common interest.

In conclusion it may be mentioned that Amsterdam is a specially appropriate place for the holding of a Congress dealing with this important question of industrial lighting, seeing that Holland was amongst the very earliest countries to include requirements of good lighting in their factory legislation.

Motor-Car Headlights

The "Depressible Beam"

ALLUSION was made in this journal some time ago to the difference in practice in the United States and Europe in regard to motor headlight design. Glare can be avoided to a great extent by limiting the beam below a specified horizontal plane; but many drivers on the Continent consider that under these circumstances they cannot drive with speed and safety on unoccupied high roads. Hence the special regulations adopted in France.

In the United States regulations have proceeded on the idea that the correct form of headlight to be used in all circumstances is that in which the upward rays are considerably curtailed. In France, on the other hand, two forms of headlights are recognized, the first suitable for fast driving on roads having little traffic; the second suited to streets in towns, etc., where many other cars are met.

There has recently been a tendency to advocate headlights with a composite beam, the most powerful beam for fast driving on lonely roads being extinguished when meeting other cars or in streets in cities that are relatively well lighted. The driver is then left with a controlled beam of moderate brilliancy, sufficient for ordinary requirements.

This idea of the double beam appears to have been met ingeniously in a form of headlight now being experimented with in the United States. This has two filaments within the same bulb. One of these, accurately focussed, furnishes the main driving beam; the other, somewhat out of focus, gives a more diffused and less powerful effect, with a "depressed beam," giving rise to comparatively little glare. The filaments are under separate control, and can be used either simultaneously or separately.

Parachute Lights as an aid to Aerial Warfare

The use of lights in various forms is evidently to be a feature in the big army "attack" conducted this month. Operations of aeroplanes are to be aided by the use of parachute flares, burning from three to four minutes. Flares of this kind formed the subject of special researches by a Committee of the Illuminating Engineering Society during the war, and types yielding upwards of 100,000 candle-power were tested. It is believed, however, that even brighter lights have now been developed. Another feature will be the conveying of information to aircraft by luminous signals. For instance, three "winks" from a searchlight will notify an aviator that he has reached a position considered unjustifiable owing to danger of anti-aircraft fire, and must retire.

Mr. M. Luckiesh

President of the Illuminating Engineering Society (U.S.A.)

MR. M. LUCKIESH, who assumes the Presidency of the American Illuminating Engineering Society at the Convention this month, is Director of the Lighting Research Laboratory of the National Lamp Works of the General Electric Co., at Nela Park, Cleveland. He is known to our readers as the author of many papers on optics and illumination, and during the war served as chairman of the Committee on Camouflage of the National Research Council. He is a member of various scientific bodies besides the American Illuminating Engineering Society, of which he has been an active member during the past fourteen years. He was chairman of the committees on glare, and on the code on the lighting of school buildings and luminaire design, and has been associated with other committees dealing with nomenclature and standards, research, sky-brightness, residence lighting and reflection factors.

It is, perhaps, as an expert on colour that Mr. Luckiesh is best known in this country. He has, however, been a prolific writer on many aspects of illuminating engineering, being responsible for no less than fifteen books on lighting, besides over 150 papers and articles in technical journals. A photograph of Mr. Luckiesh is appended.

We wish him every success during his term of office.

Illuminating Engineering Society (U.S.A.)

Nineteenth Annual Convention Sept. 15th—18th, 1925

IN our last issue we referred to the Nineteenth Annual Convention of the Illuminating Engineering Society in the United States, which took place at Detroit during September 15th to 18th.

We have now received fuller particulars of the proceedings, which included an interesting series of papers, to which further reference will be made in due course. The Convention was opened on September 15th by an address of welcome by Mr. Alex. Dow, followed by the Presidential Address, after which the usual reports of committees, including one on motor vehicle lighting, were presented. Other papers, dealing with headlights, etc., were: "Improved Automobile Headlighting," by Mr. A. W. Devine; "Depressible Beam Headlights," by Mr. R. N. Falge; "Recent Developments in Traffic Control," by Mr. C. A. B. Halvorsen.

Papers and reports, presented on subsequent days, were as follows:—

September 16th.

Report of Committee on Natural Lighting.

Paper—Practical Daylight Calculations for Vertical Windows—W. S. Brown.

Paper—Sawtooth Design, Its Effect on Natural Illumination—W. C. Randall.

Paper—Prediction of Daylight from Sloping Windows —H. H. Higbie and A. Levin.

Paper—Relative Value of Daylight, Tungsten Filament and Mercury Arc Light, and Mixtures, as Measured by Visual Acuity—Frank E. Carlson.

Paper—The Effect of Mixing Artificial Light with Daylight on Important Functions of the Eye—C. E. Ferree and G. Rand.

September 17th.

Symposium on Residential Street Lighting.

Paper—The Fading of Coloured Materials by Daylight and Artificial Light—M. Luckiesh and A. H. Taylor.

Paper—Lighting for Production—P. W. Cobb.

Paper—Lighting of Show Windows during Daylight Hours—(Demonstration) Messrs. E. D. Tillson, O. R. Hogue and Charles Howard.

Paper—Automobile Body Plant Lighting—J. M. Ketch, H. J. Thompson and E. F. Labadie.

Paper—The Illumination of General Electric Factories, Offices and Warehouses—By Works Illumination Advisory Committee—W. D'A. Ryan, *Chairman*, Ward Harrison, G. H. Stickney, C. A. B. Halvorson, junr., and H. E. Mahan.

September 18th.

Paper—Recent Developments in Neon Lamps—D. McFarlan Moore and L. C. Porter.

Paper—A Practical Form of Photoelectric Photometer—Clayton H. Sharp and Carl Kinsley.

Paper—Isocandles—Frank Benford.

Paper—New Methods of Showing Photometric Data—Samuel G. Hibben.

Paper—Reflection Properties of Chromium—R. J. Piersol.

It will be noted that the series of papers covered a wide ground, and it is interesting to observe that many of the subjects are precisely those which are occupying attention in this country.

The entertainment programme included a reception, dance and banquet, and visits for the purpose of inspecting local examples of industrial show-window and spectacular lighting.

Institution of Public Lighting Engineers

Second Annual Meeting

THE second Annual Meeting of the Institution of Public Lighting Engineers was held in Leeds during September 14th-16th. The Lord Mayor and Lady Mayoress received members and delegates at the Leeds Art Gallery on the evening of arrival. Following this, a charabanc excursion round the town for the purpose of viewing the public lighting was arranged.

The Conference was opened on the following morning. The Lord Mayor, in opening the proceedings and extending a welcome to visitors, mentioned there were now 18,000 street lights in Leeds, costing £90,000 to maintain. The task of bringing up to date methods which had been neglected during the war-period was a very considerable one, but it was a matter for congratulation that so much progress had been made. Mr. S. B. Langlands, the retiring President, returned thanks to the Lord Mayor before vacating the chair in favour of Mr. C. S. Shapley (Engineer and Manager to the City of Leeds Gas Department), the new President. A short address was then given by Mr. Councillor E. J. Clarke, Chairman of the Leeds Street Lighting Committee, who congratulated Mr. Shapley on his election.

Presidential Address.

Mr. C. S. Shapley, in his Presidential Address, gave an account of the development of street lighting in Leeds in the past. In 1883 there were 8,100 street lamps in use, all utilizing flat-flame burners; only 46 were of the three-light pattern, the rest were single burners. In 1897 consideration was first given to incandescent burners. Meantime electricity for lighting had been introduced in 1900. By 1904 incandescent gas burners were in very general use, while in 1905 there were further developments in electric lighting by means of enclosed arcs. In 1907 clock-controllers were first used, and in 1909 centrally-hung electric flame arcs were introduced. In 1913 the substitution of inverted gas burners for upright burners was begun, and in 1914 200 wave-controllers for the automatic lighting up and extinction of public lamps were adopted.

As regards the period of the war—1914-1919—the less said the better. In December, 1919, it was decided to co-ordinate the work of the Street Lighting and the Gas Department, and the speaker was appointed to general control. Only one-third of the 16,700 gas lamps were then being lighted, and the illumination from the 700 odd lower power electric lamps was poor. They were inundated by applications for relighting lamps. At the same time financial conditions were difficult, there were no stocks of lighting appliances, and the policy of lighting to be adopted had yet to be determined. However, largely owing to the enormous increase in traffic, considerable changes in the original plans have been made.

The lay-out of the city presents special problems. The industrial portion is very congested, whilst the population two miles from the centre becomes sparse. There are fifteen arterial roads emanating from the centre. Thus, though the population of Leeds is about 470,000, there are 587 miles of streets to be lighted—60 miles more than in Glasgow, where the population is roughly double. Roads have conveniently been classified as follows: (A) Arterial roads and tramway routes; (B) important connecting thoroughfares and subsidiary roads; (C) side streets; (D) courts and closes; (E) cross-roads. For Class (A) 1,000-watt gasfilled electric lamps, centrally suspended, with a spacing of 40 yds. and 24 ft. from ground to level of reflector, are adopted. In addition 500-watt and 300-watt lamps, mostly of the opal type, are suspended from the overhead trolley-wires. For cross-roads 500-watt centrally suspended gasfilled electric lamps are mainly used. Special "Caution" or "Danger" lamps are also being fixed at dangerous corners. In the other streets the method of lighting varies according to their importance. Standard 16 in. gas-lamps, taking up to three-light burners, have been widely adopted, and No. 2 mantles are standard, as giving the best illumination and longest life. The following are the actual consumptions, determined by fixing meters at the base columns of lamps at varying altitudes:

	Cub. ft. per hour.
Universal	5¾
One-light No. 2 mantle	3½
Two-light No. 2 mantle	6
Three-light No. 2 mantle	8
Four-light No. 2 mantle	10
Six-light No. 2 mantle	15

Three thousand pressure-wave controllers, all on the three-wave principle, have now been fixed. The method has proved quite satisfactory, and each lamplighter tends 160 lamps, as compared with 100 hand-lighted. Some 4,000 clock-controllers are also in use, and these too have given good results, only one repairer being required. There are six electric controllers, combining three operations in one clock, viz., lighting, checking and extinguishing. These control 53 lamps, varying from 300 to 1,000 watts. There are also 58 controllers of the "on and off" type, making the total number of lamps controlled by time-switch 303.

For maintenance a tower motor derrick is kept for general use, and for general purposes four hand-derricks are also employed. Special care is devoted to the maintenance of wires and overhead work. The Street Lighting Department is under the same roof as the Gas Department's meter-repairing and gasfitting shops, and the staffs are interchangeable and can be transferred as the need arises. The city is divided into five districts, each controlled by an inspector.

Turning to the essentials of good illumination, Mr. Shapley remarked that, whilst uniform illumination is generally accepted as the ideal, conditions must not be too monotonous. As a result of experiments, he had been somewhat disappointed by directional beam lighting. It appeared that the increase in illumination midway between the lamps did not compensate for the loss below the lamps. However, in the thoroughfares where the distance between lamps is necessarily great, the system may prove advantageous. It is sometimes an advantage to sacrifice some light for "effect"; thus clear-bulb gasfilled lamps have been replaced by similar lamps with opal bulbs, with pleasing results. The intrinsic brilliancy in the latter case was approximately 20 candles per square inch, and lights were sufficiently bright without being glaring.

Mr. Shapley proceeded to give details of some experiments, showing that illumination should not be judged by ground illumination alone; in lamps containing several mantles it was desirable to arrange the spacing so that one mantle does not screen the light from another. With two-light units such interference can be completely avoided. The effect of dazzle, Mr. Shapley remarked, is largely a matter of contrast. A moderate change of illumination is not of great moment in this respect, except when deep shadows are caused. In selecting heights for lamps some consideration must be paid to appearance. A three-light lamp on a 12 ft. column appeared too high, whereas a four-light unit at this height looked much better. Decisions in such matters must be decided largely by local circumstances.

In conclusion, Mr. Shapley remarked that the comparison of horizontal illumination, the usual method for street-lighting, left something to be desired. Gradients in the road influence illumination to an appreciable extent. People and objects are seen chiefly by silhouette and by reflected light in a vertical plane. It would be interesting to know if there was any instrument available enabling reliable readings under 0·01 foot-candles to be made.

Electric Street Lighting in Rural Areas.

A paper on the above subject, by Mr. E. C. Lennox, emphasized the need for improved street lighting owing to the great increase in fast road transport. This applies

not only to roads in towns, but to routes passing through rural areas, and good illumination becomes increasingly more urgent in order to ensure the safety of such of the rural population as use the roadways after sunset. The necessary steps should ensure the lighting up of dangerous corners and the revealing of the width of the road and the presence of ditches. Direction and danger signs should be illuminated; owing to the better lighting, the glare from motor-car headlights would be much reduced. Incidentally, by better lighting, night traffic would be increased, thus relieving day traffic congestion, whilst the greater running speed made possible would operate in the same direction. Other advantages of night illumination are the diminution in eyestrain of drivers and its value as an assistance to road-repairs.

Present-day legislation places the burden of lighting on the ratepayers of the parish concerned, the only Act applying to the circumstances being the Lighting and Watching Act of 1833. Rates made for lighting purposes cover 25 per cent. of rateable value of agricultural land and 100 per cent. of rateable value of properties. This method of assessing taxation is unfair where the majority of roads to be lighted are main roads, and operates unsatisfactorily in regard to neighbouring parishes of different rateable value. Lighting of the streets and highways is now the only public necessity left in the hands of the local parish council and provided by "local" rates. Roadways, sewerage and watching are provided out of the compound rates of the whole rural or county area. In at least one State in America a Bill has recently been passed allowing counties of the State to appropriate money for the lighting of public highways, and a board of supervisors has been set up.

In the thickly populated Northern Counties the demand for street lighting is high, and every effort is being made to meet this demand by increasing the network. Progress has been very greatly facilitated by advances in electric lamps—and particularly by the introduction of the gasfilled lamp. The construction of such lamps was described in some detail by Mr. Lennox, who also presented a table to show how, from the economic standpoint, under-running such lamps is a mistake. It cannot be too strongly emphasized that all lamps should be run at their rated voltage. Reference was also made to various methods of controlling street lighting by switching devices. Reliable and cheap switches of this kind are now available and the maintenance costs are low. Their use is of great value in ensuring that all lamps are turned on together. If lamps are lighted by hand the process takes a considerable time; some are lighted unnecessarily early, and others well after darkness has arrived. Mr. Lennox next reviewed modern fittings, pointing out the need for robust and weatherproof construction, good ventilation, provision of a suitable focussing device for the filament, and the use of apparatus to promote the best distribution of light. Fittings should be mounted as high as possible in order to secure the best results. Very even illumination and good results are obtained with units of 300 watts (4,300 lumens), mounted 25 to 30 ft. high, with spacing of 300-400 ft., and equipped with directional type reflection.

The next section of the paper was devoted to a discussion of the respective merits and costs of methods of laying cables for street-lighting schemes. For reasons of economy overhead methods are usually found necessary in rural areas. The adoption of 100 volts in preference to higher voltages has several advantages, notably the fact that the lamps are somewhat more efficient. Series street-lighting, usually fed at pressure of 2,000 to 5,000 volts, has advantages, and has proved very popular in America, but in this country overhead systems at such pressures would not be sanctioned by the regulations.

PUBLIC LIGHTING BY GAS.

A paper on this subject was presented by the Distribution Department of the South Metropolitan Gas Co., and read by Mr. J. S. Thomas. After reviewing the changing functions of street lighting occasioned by the advances in traffic, it was pointed out that the expenditure on lighting is still below what might be expected. Thus, in the County of London the police rate for 1921-1922 was 1s. 3¾d., whereas the rate for public lighting during the same period was only 3¼. Surely, Mr. Thomas remarked, modern civilization should be prepared to pay at least as much for the security afforded by an adequate system of street lighting as it is prepared to pay for police protection!

The chief features of proper street lighting are (1) adequacy of illumination, (2) minimum cost conducive with efficient service, (3) steady and constant light-sources, (4) absence of glare, and (5) maximum conservation of natural fuels. Reference was made to the various attempts to devise a standard specification for street lighting, notably that obtained by the Joint Committee on this subject and presented by Mr. Trotter before the Illuminating Engineering Society in 1913. The author, however, contends that the best means of specifying a lighting system is in terms of the polar curve of light distribution of the lamps used. Tables were presented showing the cost of lighting per mile and the lighting rate levied in various boroughs. Thus, in six boroughs served by the South Metropolitan Gas Co., low values are recorded, the average being £132 per mile per annum cost, and the average lighting rate 1·62d. Other data show the vast increase in the amount of light provided in the area supplied by the South Metropolitan Gas Co. during the period 1899 to 1913. In the former year there were 20,998 public lamps, yielding on an average 2·5 candles per cubic foot of gas consumed; in 1913 there were 24,713 lamps, yielding 19 candles per cubic foot. Whilst the gas consumption had diminished from 478 to 371·5 millions of cubic feet per annum, the candle-power furnished had increased from 280,000 to 1,700,000. Advances in the form of substituting inverted cluster burners since 1913 must have led to a yet greater advance. In this connection striking figures were quoted for Newcastle-on-Tyne, where, by substituting modern burners, annual savings in the cost of gas and mantles, or of £2,584 and £2,723, had been made.

The Gas Regulation Act (1920), facilitating the provision of gas of a declared and constant calorific power, had been of great importance in enabling the burner and mantle to be standardized. In the case of the public lighting undertaken by the South Metropolitan Gas Co., standardized burners, with fixed proportions of gas and air consumed, had been a great success, both in ensuring constant lighting conditions and in enabling burners to be produced cheaply by bulk-supply.

A series of diagrams were presented showing the advances in efficiency secured by modern superheated cluster units, aided by arrangements to direct the light in the desired direction, as embodied in the "Metro" directional reflector lamp. Another feature is the increase in efficiency as the number of units in a cluster is increased. Thus, whereas the efficiency of a one-light cluster is about 51 candle-hours per centi-therm, the efficiency of a 16-light cluster is 66 candle-hours per centi-therm.

The paper was illustrated by numerous polar curves of typical lighting units and photographs of installations taken by night, showing the lighting conditions in various cities.

DISCUSSION.

In the discussion various speakers agreed as to the need for better public lighting, especially in arterial thoroughfares and rural routes carrying a considerable volume of motor traffic. Mr. H. E. FRYER (head of the Road Department of the Automobile Association) remarked that, from the motorist's standpoint, the present overhead system of lighting was not ideal. He suggested that adequate illumination of the roadway could be better obtained by sources with appropriate reflectors placed at a relatively low level at the side of the road, so as to flood the surface with light and ensure absence of glare. Such conditions might well be tried on arterial routes where the guidance of traffic was the main consideration.

Mr. A. C. CRAMB, Borough Engineer for Croydon, also alluded to the lighting of roads carrying heavy

traffic, and remarked that the lighting of some of the arterial roads passing out of London southwards was in parts quite inadequate for modern traffic conditions.

Mr. L. GASTER, who was present as the Hon. Secretary of the Illuminating Engineering Society and a representative of the National Safety First Council, also strongly urged the need for better lighting in the interests of safety. He pointed out that existing statistics, rightly interpreted, led to the belief that an unduly large number of street accidents occurred at night, and were traceable to inadequate lighting. He suggested that every fatal accident in the street should be made the subject of inquiry, when the influence of lighting conditions would be manifest. Local authorities had a direct responsibility for accidents due to inadequate lighting. Fuller information was needed in order that the need for proper lighting could be brought home to the public by facts and figures, and they would then willingly acquiesce in the necessary expenditure.

THE LUNCHEON.

At the luncheon, given in the Lord Mayor's Rooms on September 15th, Alderman George Ratcliffe presided. After the usual loyal toast, the "City of Leeds" was proposed by Sir Albert Ball, of Nottingham, and responded to by the Lord Mayor, Alderman Charles Lupton, and Councillor J. Arnott.

"The Institution of Public Lighting Engineers" was proposed by Alderman George Ratcliffe (Chairman of the Leeds Gas Committee), who recalled the saying that "one lamp is worth two policemen." Mr. C. S. Shapley and Mr. S. H. Langlands, in replying, expressed the thanks of those present for the hospitality of the Corporation.

The final toast of "Our Guests" was proposed by Councillor E. J. Clarke (Chairman of the City of Leeds Lighting Committee), and responded to by Alderman Waddington (Mayor of Halifax) and Abraham Wilkie, who conveyed an invitation for the next Annual Meeting to be held in Newcastle-on-Tyne.

Lighting Conditions and Industrial Accidents

THE relation between good lighting and safety is being studied energetically abroad as well as in this country. At the second technical congress of the "Association des Industriels de France contre les Accidents du travail," a paper was read by M. Maurice Leblanc emphasizing the great importance of good industrial lighting in the interests of safety. He recalled the figures presented in the United States, leading to the conclusion that 18 per cent. of the industrial accidents are due to bad lighting. In France a minimum illumination for safety of 1·5 lux (approximately 0·15 foot-candles) has been prescribed (this is presumably irrespective of the actual working illumination).

Subsequently M. Leblanc analysed in some detail the essentials of good lighting, dwelling especially on the necessity of avoiding glare and troublesome shadows or excessive contrasts. He mentioned instances in which unsatisfactory illumination had led to accentuation of defects of vision amongst workers. Finally he discussed the best arrangement for emergency lighting, and the precautions that should be taken to eliminate any possibility of panic in the event of the general system of lighting failing.

There were also other communications dealing with various aspects of the use of electricity, treated from the safety standpoint. Thus M. Courtois dealt with protective measures against high pressures on distribution circuits, and Mr. Arnaud discussed in general terms the application of electricity in factories, summarizing the chief regulations made in the interests of safety.

Institute of Journalists

Annual Conference at Cambridge, August, 1925

AT the Annual Conference of the Institute of Journalists, held in Cambridge last month, a number of questions of considerable moment to the journalistic profession were discussed. From its inception the Institute has been occupied in efforts to raise the status of the journalist, and secure more satisfactory conditions of employment. In particular the journalist has hitherto been in an unsatisfactory position in regard to tenure of his appointment. The success of a journal is in a very large measure dependent on the efforts of the editor and his staff. Consequently it may be urged that a long association and many years of service should not be overlooked in the event of a change of proprietorship. Cases have occurred in which, owing to such changes, frequently involving an alteration in the policy of a paper, an editor's connection with a paper has been abruptly terminated. In this event he should be entitled to adequate compensation. In the Report of the Council it is pointed out that the relatively satisfactory present position of journalists and journals with respect to reasonable notice for the termination of contracts of service is entirely due to establishment by the Institute of professional status as the basis of its action; in many cases it has been possible, by friendly representation, to secure an equitable settlement.

This matter is evidently closely allied with the question of the education and training of the journalist, and it is satisfactory to note that the Council is considering proposals for further increasing the facilities for associating adequate training with personal and educational qualifications. It is hoped that the efforts of the Institute to improve the standards of remuneration will, in proportion to their success, operate to encourage young people of suitable capacity and education to enter the profession.

Whilst thus occupying itself with the status of the journalist, as affected by culture, education and social qualities, it was interesting to note that the proceedings also indicated a new outlet for the journalist in the diplomatic field. It must, we think, be conceded that a man who ultimately becomes an ambassador should—whatever supplementary journalistic experience he attains—have passed through the full course of diplomatic training. But it was suggested that the importance of the position of the "press attaché" is not sufficiently realized, and that this position might well be filled by men who, after experience of the diplomatic service, have graduated by education and experience in the journalistic field. There would then be no obstacle to such press attachés ultimately rising to the top of the diplomatic profession. Meantime they would be carrying out duties of great national importance; for there can be no question that a diplomatic agent fully familiar with the work of the press, and able to keep in touch with journalists in this or other countries, may exert a very powerful influence.

The proceedings included a report on propaganda methods with a view to making the work of the Institute more widely known and appreciated. One was also glad to observe that steps are being taken to promote relations with other journalistic bodies, and it is much to be hoped that means of bringing them into friendly co-operation will be found, the Institute as a chartered body retaining its proper status on any scheme of amalgamation that may be proposed. Whilst not desiring to make any distinction between the various journalists who are doing much to uphold the high ideals of journalism, we should like to make special mention of the valuable services rendered by Mr. Frederick Peaker during his three years' tenure of office as President of the Institute.

POPULAR & TRADE SECTION

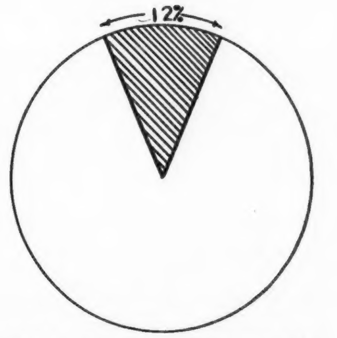
COMPRISING

Installation Topics—Hygiene and Safety—
Data for Contractors—Hints to Consumers

(The matter in this section does not form part of the official Transactions of the Illuminating Engineering Society; and is based on outside contributions.)

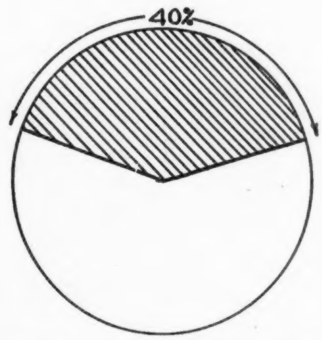
A Note on the Lighting of Shop Interiors

THE advance that has taken place within the last few years in the science and art of lighting shop windows is by now sufficiently widespread in practice to be known and appreciated by most people. Without, perhaps, always realizing "how it is done," the general public is undoubtedly conscious of the fact that the shop window of to-day is far more seductive than the shop window of yesterday. This, it is true, is largely owing to the great development made in window dressing, yet when all allowance is made for this new art, much still remains to the credit of lighting.



LOSS WITH TOTALLY ENCLOSED DIFFUSING UNITS IN FOUR WEEKS

FIG. 1.



LOSS WITH SEMI-INDIRECT UNITS IN FOUR WEEKS

FIG. 2.

FIG. 3.—A good example of Shop Lighting by totally enclosing units.

Meanwhile, a change, less evident, perhaps, but no less real, has taken place in the shop interior. No longer is the low pendant fitting, with its bare lamp and conical shade, deemed the summit of lighting equipment. In all up-to-date stores it has been replaced by something designed on more scientific lines. As in the case of the shop window, this equipment for the interior is primarily designed to aid the customer in selecting and making his purchases. By means of a well-diffused light, the whole shop is evenly illuminated, and the customer is able to distinguish the wares in all directions. Not only this, but there is also the fact that such a cheerful "atmosphere" will impress itself upon him, and recur enticingly to his memory when a future purchase is necessary. Then, of course, there is the very important point of enabling the assistants to find any of the goods required as conveniently as possible.

Of the several types of fittings designed to diffuse the light they shed, undoubtedly the most satisfactory under normal conditions is that known as the "totally-enclosing" unit. This is made of diffusing glass, of one kind or another, and completely encloses the lamp. One great advantage this type has over others is that it is comparatively free from dust settlement, and is particularly easy to clean when dust has settled upon it. A glance at Figs. 1 and 2 will suffice to convince the reader that this advantage is no mean one; for it will be seen that even in such a fitting as this the loss of efficiency in the course of four weeks owing to dust and insects settling upon the surface, amounts to 12 per cent., while in the case of other types it mounts as high as 40 per cent. Evidently, therefore, in a large store situated in a smoky city this is going to cause a serious waste of money on electrical energy consumed to no purpose.

A good example of lighting a shop interior by means of totally enclosing units is shown in the third illustration. It will be seen that the whole area receives an adequate and even illumination. No harsh shadows are present, and glare is completely avoided.

The fourth illustration shows a novel way of lighting an interior—namely, through a sub-skylight. Here the

"ceiling" consists of frosted glass, which forms an excellent diffusing medium. Above this are placed a number of powerful gasfilled lamps. Such an arrangement gives, perhaps, as near an approach to daylight as it is yet possible to attain.

Under certain circumstances, where a particularly subdued light is required, semi and totally indirect fittings may be used with good effect. Owing, however, to their relative inefficiency and the amount of dust they collect in the course of a few weeks, they are not recommended for general use.

In addition to these general remarks on shop lighting, one or two more may be added regarding matters of minor importance, yet matters which may add to or detract from the comfort of the customer. There is, for example, the question of reflections in show cases. These may be overcome by installing suitable reflectors inside the cases and raising the light intensity inside these cases to a degree at least as high as that of the shop itself. Another point worth noting is the use of illuminated signs, indicating direction and departments in a large store, where a customer will always be grateful for a little assistance.

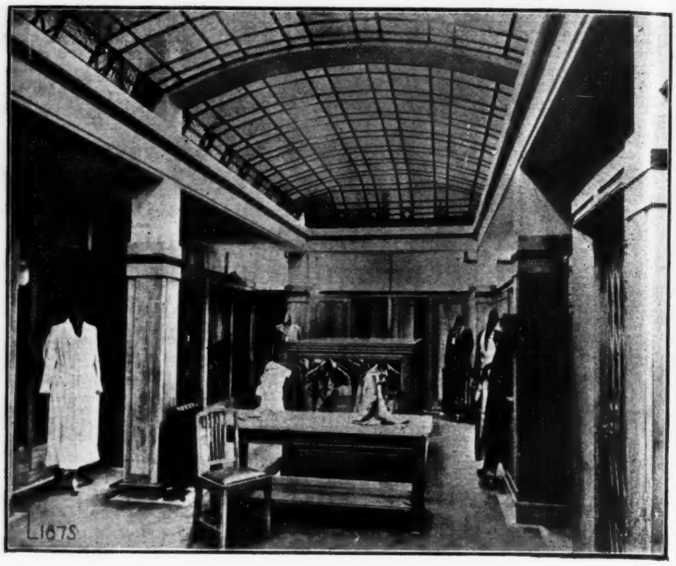


FIG. 4.—A Novel Way of Lighting a Shop Interior by totally enclosing units.

Finally, there is the matter of emphasizing some particular display inside the shop. For this purpose a dais may be constructed to carry the selected wares, and then, by means of floodlights, with or without colour screens, according to circumstances, it may be picked out from its surroundings in a very effective manner.

Artificial Lighting in Churches and Cathedrals

By a Correspondent

THERE is a great opportunity for the exercise of the skill of the architect and the illuminating engineer in the artificial lighting of the cathedrals and the many old churches scattered about this country. It is curious how perfunctory the treatment of lighting in such cases often is. It is indeed unusual to find one in which the artificial lighting is quite satisfactory. The view that modern illuminants in such surroundings are incongruous and an anomaly, and that the only truly artistic course is to retain the original oil lamps or candles, is consistent and entitled to consideration—even though one must consider that nowadays this course is impracticable. But when the decision to adopt gas or electric light is once made, those responsible should make every effort to render the anomaly of new illuminants in old surroundings as inconspicuous as possible. Instead of this one finds unscreened filaments and mantles in evidence, and sometimes no attempt whatever to enclose them in a fitting in keeping with the interior.

These remarks are prompted by the writer's experience during a recent visit to the Cotswolds, where fine old churches are exceptionally numerous. The parish church is almost always a prominent object, frequently on a height and dominating the town. One can realize how in the past no service was grudged to make the interior dignified and impressive. Now, in many cases, the intrusion of modern illuminants is manifest.

One finds, for instance, bare lamps mounted direct on the wall beside arches, or in the old "squint-holes" in the choir. Curiously enough, it is not infrequently in the choir, where good illumination is most needed, that the least satisfactory methods of lighting are adopted. A case in point is afforded by the choir in Gloucester Cathedral. The carving of the woodwork in this choir, and the curious ornamentation of the desks, is famous. It is, therefore, a shock to find that the lighting is provided by metal-filament lamps (frosted, it is true, but furnished with no form of shade or reflector) mounted on bent tubing at intervals of a foot or so along the wall and making a complete circuit of the desks. There is no attempt to disguise the illuminant in a fitting of ecclesiastical design. The arrangement is not even efficient, for it will be realized that lamps with vertical filaments equipped with no reflector, and mounted about ten or twelve feet above the choir desks, will direct only a very small proportion of their light in the direction where it is needed.

The guiding principles to correct lighting in such cases are two, (1) the source, whether an electric filament or a gas mantle, should be mounted in a fitting as closely in harmony as possible with the style of the interior, and furnished with diffusing glass so that the exact nature of the source cannot be seen, and (2) the unit should be reasonably efficient, i.e., equipped with a reflecting surface which ensures that the majority of the light is directed where it is mainly needed. These steps may involve some extra additional expense. But, on the other hand, the use of efficient fittings will mean that a smaller consumption of energy or gas is needed to furnish the necessary illumination—much less, for instance, than in the case mentioned above!

In the general lighting of churches the screening of all bright lights liable to dazzle the eyes is the dominant consideration. What, therefore, can one say of the method employed in a famous church in Bristol, where the arches are outlined in bare metal-filament lamps in a manner reminiscent of the worst traditions of exhibitions? It may be that, from the artistic standpoint, the introduction of modern illuminants in an old building is to be deplored. But it is strange that those responsible for the lighting of churches sometimes make so little effort to render the new procedure unobtrusive!

Under-water Lighting in a Bathing Pool

A problem of some interest, which presents certain difficulties, however, is the "under-water" lighting of bathing pools and swimming baths. As a safety precaution, lighting of this kind, if properly contrived, should be valuable, as the motions of swimmers can be followed by spectators, and if they are overcome by exhaustion or cramp when below the water, this can be determined in good time. It should also render diving and swimming under water much more interesting to spectators. We notice that in the United States this plan has been successfully adopted in the Mission Beach bathing pool at San Diego. Illumination is provided by a set of seven floodlights embedded in the walls of the pool at its greatest depth of 9 feet. The lighting units are enclosed in a large pyramid-shaped casting, having a vent at the top leading through a goose-neck to a manhole at the back of the pool-walls. The unit is protected from the water by 7/16 Pyrex glass (the selection of a heat-resisting glass, not liable to crack, is an essential feature).

Further Lighting Spectacles at Wembley

Many of the most impressive spectacles at Wembley and elsewhere depend on the use of special lighting effects. The reproduction of the attack on Zeebrugge is a case in point, likewise the "London Defended" show where the flames of apparently ruined buildings are merely optical illusions produced by the cunning use of projectors and fireworks. The great military Torchlight and Searchlight Tattoo is essentially a lighting display, and was singled out for special mention in the review of progress in illuminating engineering issued by the American Illuminating Engineering Society last year.

Apart from the lighting of the grounds of the Exhibition, already described in these columns, and the regular fireworks displays, mention may also be made of an interesting experiment being carried out in the Post Office section of the British Government Pavilion. Here a crown, a replica of that in the Tower of London, studded with forty small electric light bulbs, is lighted by electric waves emitted by a high-frequency generating circuit some distance away. This, of course, is only an experimental demonstration of the wireless transmission of power for lighting, but may one day be looked back upon as an interesting historical event. Then, in the Royal Society's section of the Government Building there is a demonstration of spectroscopy, and its use in analysing the light of the stars, whilst in the Miracle Theatre Duveen's many illusions, notably that showing the apparent building up of a human body from a skeleton, are again examples of how effects of light and colour may deceive the eye.

Towers for Carrying Searchlights

We notice in *The Electrical World* a description of searchlight towers that rise and disappear as an essential in seacoast service. Towers so far built range from 45 feet to 100 feet in height, but are of uniform design. At the top of the steel frame is a swinging platform on which the searchlight is centrally placed. One tower can be completely operated by a single man, and searchlights yielding about four billion candle-power are being installed.

The Darkened Room

Under the above title the following pleasing little poem appeared in a recent issue of *The Observer*. It is perhaps significant as illustrating how general the conception of the beneficial effects of light have become.

The room was full of lovely things.
  We held the candle high in air
And gazed with joy that beauty brings
  On all the treasures gathered there.
Then—one of us—by accident
  Blew out the candle and brought night!
Groping—about the room we went;
  The treasures hidden from our sight

* * * *

My house of life is very fair,
  And decked with treasures all about;
But I see nothing anywhere,
  For you have put my candle out.

H. R. B.

Spectacular Lighting at Pretoria

From all accounts, the recent tour of His Royal Highness the Prince of Wales to South Africa was accompanied by much spectacular and festive illumination. On such an occasion, light, the traditional means of celebrating periods of rejoicing, played a great part.

The three illustrations above, furnished by the General Electric Co., Ltd., give a good idea of the effects produced. They represent three sides of Church Square, Pretoria, in the lighting of which large numbers of Osram lamps were used. Evidently South Africa, like the mother-country, can turn out spectacular lighting effects when the opportunity presents itself.

Prejudice against Lighting Improvements

PREJUDICE is one of the most difficult obstacles which all pioneers have to overcome. The development of steam as a means of transport by land and sea was hindered for a long time by public apathy, and the same might be said of many other inventions and discoveries which have improved in vast measure the lot of the masses.

Two typical illustrations of the exercise of this retarding influence upon much-needed and greatly overdue improvements in lighting show that illuminating engineers must sometimes be almost aggressive in order to convince factory owners and their employees of the advantages of good lighting.

The first case arose in a large boot factory in London, in which it was discovered that flat-flame and obsolete types of incandescent gas burners were in use. Immediate steps were taken to determine the degree of illumination provided by these burners, and, as was to be expected, it was found to be very poor. In the neighbourhood of the lasts, where flat-flame burners were being used, an illumination of only 0·9 to 2·5 foot-candles was provided, the higher figure being attained by the placing of the burner so near to the work that it seemed almost as capable of burning the shoes as it was of illuminating them. The burners were fixed upon hinged fittings, and the workmen took full advantage of the opportunity of moving the light to the place which suited them best. It was suggested that a modern system of gas lighting would provide a higher and more uniform degree of illumination, and also that it would save gas but this statement the workmen frankly ridiculed. The works manager considered it advisable to ascertain the views of the operatives before any drastic change was made, and he had considerable difficulty in convincing them of the possibility of big improvements being effected. In the end it was agreed that one inverted gas lamp should be put up, for trial by one of the workmen. This was done. The illuminating engineer called a few days after the lamp had been installed and found that the man working under the new lamp was the object of envy by the other workmen, and from that moment onward the remodelling of the whole lighting installation of this factory was carried out without any difficulty. The average illumination values of the old and new systems were as follows:—

Flat-flame burners, 1·60 foot-candles.

Inverted incandescent gas burners, 7·40 foot-candles.

These figures do not, however, tell the whole story. The flat flame burners were generally so near to the work as to dazzle the eyes of the man, whereas the inverted incandescent gas lamps were well out of the range of vision. Again, the illumination provided at various points of the work-bench by the flat-flame burners varied from 0·9 to 2·5 foot-candles; that is to say, the ratio between maximum and minimum was $\left(\frac{2\cdot5}{0\cdot9}\right) = 2\cdot8$. In the case of the inverted incandescent gas lamps the variation was from 6 to 9·7 foot-candles, that is to say, a ratio of $\left(\frac{9\cdot7}{6}\right) = 1\cdot6$. The new installation therefore gave $4\frac{1}{2}$ times the illumination of the old one, and was much more uniform. *Moreover, it decreased the consumption of gas for lighting by about 50 per cent.*

The second case arose in a large workshop where skilled men were engaged on fine work on metal—the production of silver cases of various kinds, silver ornaments for brushes, hand mirrors, and the like. Here again (despite the fact that the inverted incandescent gas burner had been almost universally adopted elsewhere wherever gas was used as the illuminating agent) flat-flame burners on double-arm brackets were used. The first opposition to improvement came from the manager. He found it difficult to realize that a representative of the gas undertaking could possibly be anxious to interest him in a scheme which would halve his lighting bill. This suspicion having been banished by a common-sense statement of the case, the next problem was the tackling of the workmen, as the manager was disinclined to do anything that did not meet with their approval. A long conversation with the foreman revealed the fact that the men honestly believed that flat-flame burners were the very best thing for their particular work. They attached great importance to the movability ensured by the double-arm bracket. In the end, however, the foreman and one of the workmen agreed that one incandescent gas fitting should be installed. As movability was insisted upon, a "Surprise" pendant was used. The illuminating engineer called at the works a short time after the installation of the light, and found that hostility to the improvement had distinctly softened. Although at first the workman had made use of his ability to vary the position of the inverted burner provided, he had ultimately found a position for it which met all his requirements, and the need of movability had therefore become non-existent. A careful note was made of the position he had selected, and when the whole of the lighting of the factory was finally dealt with this information was very useful. Needless to say, a carefully selected shade was provided with the incandescent burners to eliminate all glare effects.

The flat-flame burners that had been used in this case were rather large ones, consuming between six and seven cubic feet of gas per hour. They were in most cases fixed so near to the working point as to give an illumination of 2·3 to 5·3 foot-candles at the working point, but the dazzle due to this nearness undoubtedly limited the dexterity of the men.

It was a significant point in this instance that, owing to the operation of certain rules, the men were debarred from doing the particular job in less than a specified time, so that the argument that better lighting enabled more work to be done did not make a strong appeal either to the manager or the men. The saving in gas, after the manager was convinced that this would be effected, of course, had its appeal to the owners of the factory, but undoubtedly the main deciding factor in bringing about the change in this case was the brightness and cheerfulness of the improved system compared with that of the old one.

Probably every illuminating engineer has met with experiences somewhat similar to those described in the above notes. The knowledge, however, that he has at his disposal the high-pressure gas burner, the more recent superheated cluster burner and a wealth of shades and reflectors to assist him to ensure any desired effect, will enable him to meet with confidence and success opposition of this kind which is sure to be encountered from time to time in the course of his work amongst a population so proverbially conservative as ours.

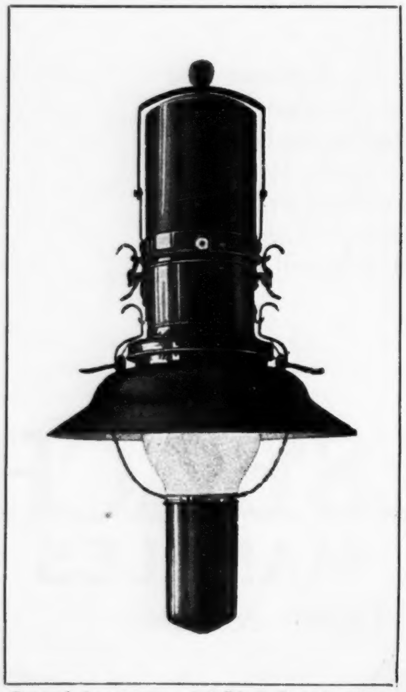
The Marvel of the Modern Lamp

Probably few people who use modern lamps as a matter of course realize how many years of patient experiment have been required to bring them to the present stage of perfection, and how many scarce materials, drawn from all parts of the world, are needed for their production. The application of the rare earths thoria and ceria in the gas mantle is a famous chapter in history. These earths come from the monazite deposits in distant lands, for example, in Travancore and Brazil; ramie fibres for the fabric come from the East; artificial silk is now taking the place of the natural material. The modern electric lamp requires materials coming from an even wider range of countries. Some of these elements are felspar from Sweden, manganese from the Caucasus, potash from Germany, shellac from India, tin from the Malay States, tungsten from Japan, sodium carbonate from British East Africa, tryolite from Greenland, cobalt and nickel from Ontario, nitre from Chile, and molybdenum from Quebec.


Still the Best—
for all lighting purposes
Upright or inverted, the Welsbach Gas Mantle still represents the ideal form of lighting for all purposes, for the factory or the home. Invented nearly forty years ago, the Welsbach is without rival among a host of competitors. The Pioneer Mantle of the World, it is still the best.
WELSBACH
GAS MANTLES
BRITISH MADE
WELSBACH
WELSBACH
A WELSBACH HOUSE IS ALWAYS A LIGHT HOUSE
P. P.S. 237.

The New "Dia" Long-Burning Flame Arc

IN our April issue (p. 90) we referred to a new form of long-burning flame arc lamp developed in Germany. We have now had the opportunity of examining one of these lamps which has been developed in the laboratories of Messrs. Korting and Mathiesen, and is now on view at the showrooms of the Photector Co. in Westminster (4-12, Palmer St.). The lamp has excited much interest and appears to have given very promising results in Berlin, and a number are now to be seen in this country. There were, for instance, several on view during the I.M.E.A. Convention at Brighton. There are several now erected outside the Coliseum, and we understand that others are being put up in Acton and elsewhere.



General Appearance of "Dia" Long-burning Enclosed Flame Arc Lamp.

The chief feature of the lamp, the general appearance of which is shown in the accompanying picture, is the method of enclosing the arc in a specially designed and almost completely sealed inner globe. In the illustration the surrounding outer globe is seen, and the space between this and the inner globe helps to maintain the latter at a constant high temperature. As a consequence there is no material deposit of fumes over this light-giving area; the slight film that deposits only tends to diffuse the light somewhat and has little absorption.

Deposit of fumes occurs mainly in the cooler portions of the inner globe, i.e., in the lower region covered by the casing at the base of the lamp and in the expanding upper globe, which is located inside the upper reflector.

The deposit on this upper surface is considered no drawback, but rather an advantage, as the mat white material deposited has excellent reflecting properties. Successful operation of the lamp depends largely on the special carbons adopted which yield a pale golden light.

The lamp is at present being constructed mainly for direct current, and will operate on 8, 10 and 12 amperes, two lamps being conveniently operated in series on 110 volts; with lamps in series on pressures exceeding 220 volts a special substitution resistance is provided. The following data regarding its performance are of interest: —

Period of burning of a single pair of carbons, about 120 hours.
Consumption, according to type, 440-660 watts.
Candlepower, 2,000-3,600 (hemisph. H.K.)
Spec. Consumption, 2.22-0.18 watts per H.K. (hemisph.)
Flux of light, 12,500-22,500 lumens.
Efficiency, 28-34 lumens per watt.

The above figures represent performance with lamps over the range of currents specified, and assuming an outer globe of opalescent glass. Even without an opalescent globe the light appears to the eye well diffused, owing to the long arc and the effect of the thin film of deposit; but it is recommended, in order to obtain a thoroughly diffused light free from glare, that the opalescent globe should be used.

From the polar curve before us the maximum candlepower appears to be located about 30° below the horizontal.

The advantage of this exceptionally high efficiency for an enclosed flame arc lamp is evident, and the long period of burning removes to a great extent one of the chief objections to flame arcs as compared with gasfilled incandescent lamps for street lighting. This new lamp will be watched with interest and we hope in the near future to be able to show some pictures of actual installations.

Propaganda on the Benefits of Good Lighting

The Value of Photographs of Installations as an Appeal to the Eye

ONE is glad to note the growing recognition of the fact that one of the best methods of approaching the public in matters of illumination is by the aid of *an appeal to the eye.* Best of all, usually, is an actual visit to a factory, street, shop, etc., where the actual conditions of illumination may be examined. Next come demonstrations. To see a fitting lighted up is very much better than an illustration in a catalogue! On a small scale, a well-lighted model of a show window can bring out points which may not be so evident in an actual practical case—for in a demonstration one can plan and select conditions for the purpose of illustration, whereas in practice one must be to some extent guided by the views of the customer.

Demonstrations of lighting effects, such as those being arranged by leading organizations in this country, on the Continent, and in the United States, are therefore growing in favour. This is a branch of work that ought to be energetically taken up by gas and electric supply undertakings throughout the country.

But such methods can be effectively supplemented by propaganda literature, and it is here that the need for still maintaining an appeal to the eye is so manifest. A good illustration may convey at a glance a lesson which could only be brought home by a lengthy description in words. Ever since *The Illuminating Engineer* was started we have emphasized the importance of photographs of lighting installations showing, as nearly as possible, the actual conditions under artificial light. Such photographs should be taken solely by the aid of the light furnished by the units installed; a false impression may at once be produced if they are, for example, aided by "flashlight" methods.

The two illustrations on the opposite page are selected from a series of attractive leaflets being issued by the Benjamin Electric Co., Ltd., and show the merits of good photographs. The upper illustration relates to a cutting-room in a clothing factory as seen by daylight. This is a class of work requiring specially good conditions in regard to shadow; troublesome shadows from badly placed or imperfectly diffused sources of light are very liable to cause mistakes. Hence the advantages of the best natural lighting. The second illustration shows the use of modern overhead lighting with gasfilled lamps in R-L-M reflectors. The aim is to flood the room with light and to arrange the sources in such a way that light always comes from the right direction—so that the worker is never "in his own light."

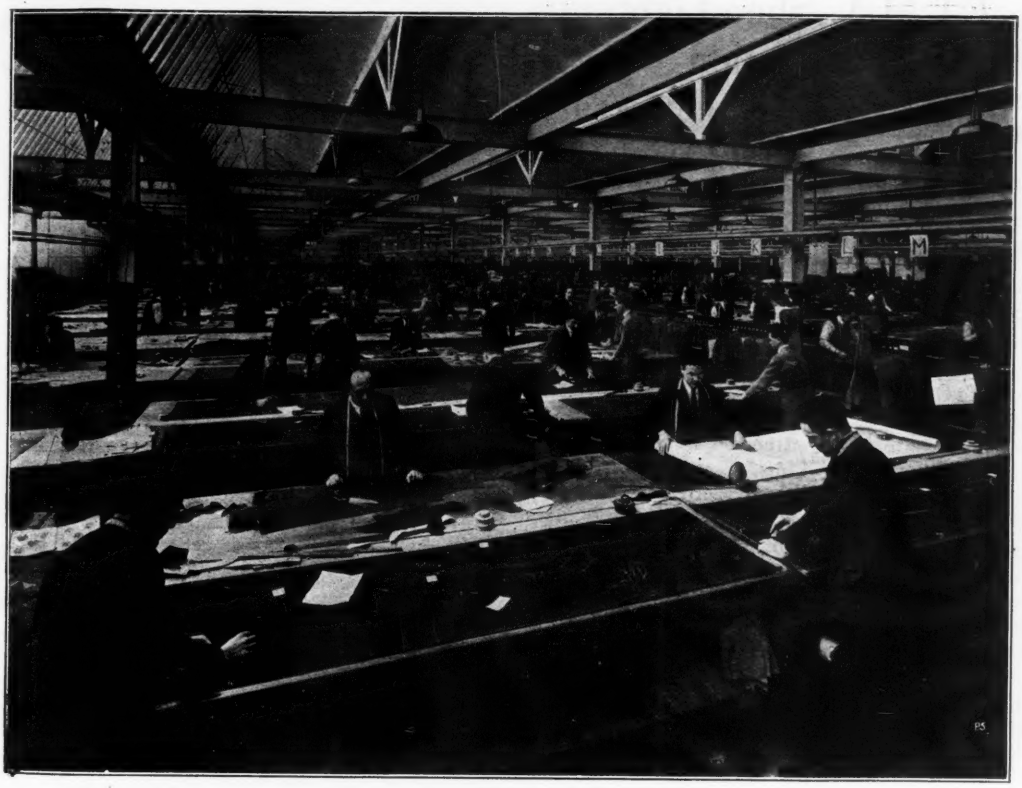


FIG. 1.—Showing the conditions of illumination in a Cutting Room under good daylight conditions.

FIG. 2.—Showing conditions of illumination in the same room by artificial light—overhead gasfilled lamps in Benjamin R-L-M Reflectors.

The E.L.M.A. Shop-Lighting Demonstration

VISITORS to the premises of the E.L.M.A. Lighting Service Bureau, at 15, Savoy Street, London, will find that a remarkable change has come over the lecture hall during the last few weeks.

The ceiling has now been completely roofed in, but dropping panels, operated from outside the theatre, enable a series of different lighting fittings to emerge through the ceiling in succession. When, for instance, it is desired to demonstrate the difference between the effect of a bare lamp and a modern lighting fitting, the appearance of each type in turn from above is much more dramatic than the old arrangement, and inevitably attracts the attention of the audience.

For the immediate future attention is being devoted specially to shop-lighting. Thus, along the side of the room where the fittings emerge, modern shop-counters, filled by typical goods, are installed. On the other side of the room counters with a suitable background painted in are also available. At the entrance to the hall there are several fully equipped shop-windows, one with a complete colour-changing equipment, and containing an appropriate display of dresses in well-selected hues; also a rack containing specimens of the latest shop-window units, each with its separate switch.

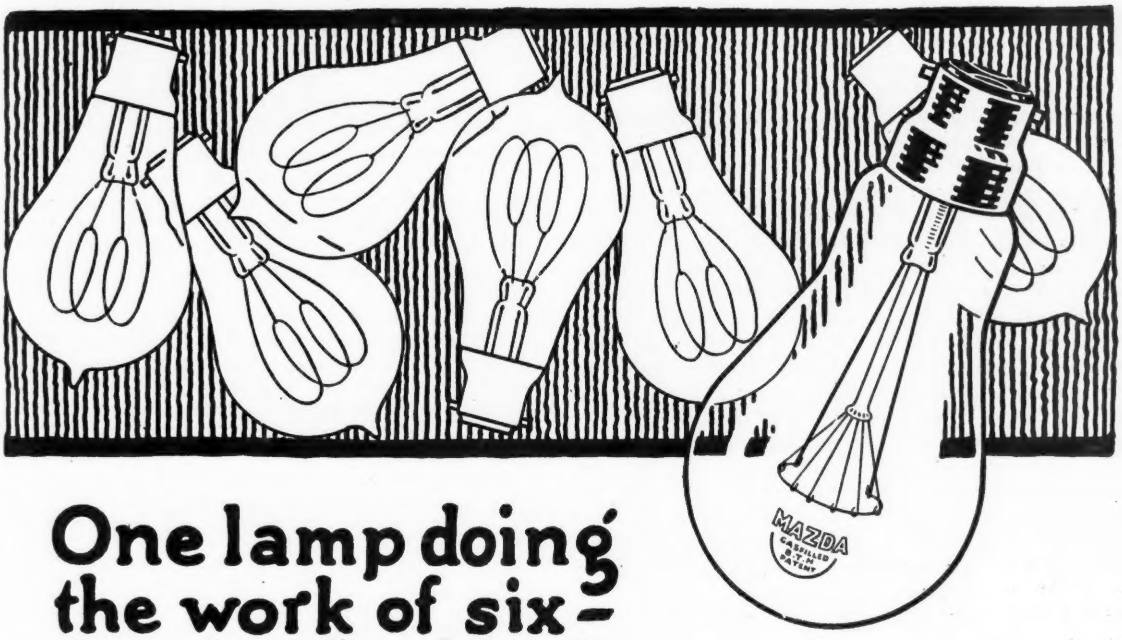
Incidentally, there are several other novelties. A revolving platform divided diagonally enables different scenes to be presented to the audience (for instance, typical dwelling rooms in succession), one scene being arranged, if necessary, whilst another is being displayed. There are also travelling trunks for demonstrators, each containing the make-up of a convenient stand from which a good and bad type of lighting units may be hung simultaneously and compared.

Recent literature issued by the E.L.M.A. Lighting Service Bureau includes "Light as a Sales Force," a very simple and popular production; "Light and the Shopkeeper," a complete lecture suitable for delivery before Chambers of Commerce, Tradesmen's Associations, etc.; and "A Survey of Lighting in 800 Retail Shops," the latter a reproduction from *The Illuminating Engineer* of the paper read by Messrs. W. J. Jones and H. Lingard before the Illuminating Engineering Society. *The Electric Illumination Bulletin* for August also contained a considerable amount of useful information on shop-lighting designs, including plans of lighting installations and photographs showing the results.

Notes on Exhibits at the Annual Meeting of the Institution of Public Lighting Engineers

ACCORDING to information received, there was a varied display of modern street lighting apparatus at the Annual Meeting of the above body, held in Leeds this month. Thus, Holophane Ltd. had arranged for the installation of Holophane refractors in Infirmary Street and East Parade, and also for an assembly of types in the Town Hall. Messrs. Siemens and English Electric Lamp Co. Ltd. had on view typical weatherproof lanterns for gasfilled lamps, fitted with anti-vibration discs, and also the "Rodalux Fitting," a new type with directional cylindrical reflecting surfaces specially adapted for the longitudinal lighting of streets, platforms, carriage drives, etc.; also a display of Benjamin reflectors of the R.-L.-M. and Distributing type. The British Thomson-Houston Co. Ltd. drew attention to the use in Lower Briggate and Briggate of special lanterns (Type 484), with 500-watt Mazda gasfilled lamps, whilst in Vicar Lane the "Superla" lantern for 1,000-watt gasfilled lamps was shown. Other street lighting equipment was shown in the Victoria Hall. Other modern street lighting fittings were exhibited by the General Electric Co. Ltd. and the Edison Swan Electric Co. Ltd., whilst the exhibit of Cryselco lamps was illustrated by a leaflet containing some attractive illustrations of street lighting in Leeds with the opal-type lamps, which are also being used at Waterloo Station.

Amongst gas-lighting exhibits, Messrs. Wm. Sugg & Co. had on view along the line of route Rochester Suspension Lamps fitted with Metropolitan Controllers, and a series of Lyttleton and Rochester Suspension Lamps in the Victoria Hall. Forms of "conversion sets" and cluster units in lanterns were shown by Wm. Edgar, of Hammersmith; Messrs. Falk, Stadelmann & Co. Ltd. likewise showed conversion sets; also street lighting burners and the "Veritas-Alpha" hard silk flexible incandescent mantles (for which remarkable resistance to shocks and vibration are claimed). A variety of lanterns were shown by Messrs. Foster & Pullen, of Bradford, who had also lighted for the occasion a section of Kirkstall Road, where the lanterns were actuated by "Newbridge" detachable controllers of the latest pattern. Amongst others who exhibited may be mentioned Venner Time Switches Ltd., C. H. Kempton & Co., The Automatic Light Controlling Co., and Messrs. Alder & Mackay—the latter two firms being responsible controllers for automatic street lighting.



One lamp doing the work of six—that is what Mazda progress means

It is only a relatively short time ago that the carbon electric lamp was looked upon as a triumph in the science of lighting. The Mazda drawn wire metal filament lamp, giving three times the light for the same consumption of current, soon made the carbon lamp right out-of-date. To-day even this efficiency has been greatly surpassed by the Mazda Gasfilled Electric Lamp, which gives the lighting effect of six carbon lamps. The Mazda Gasfilled Lamp represents an outstanding achievement in electric lighting.

All Electricians Ironmongers and Stores sell them

MAZDA
GASFILLED
ELECTRIC
LAMPS

B T-H

1829

Novelties in Spectacular Lighting

A Visit to the Works of the Strand Electric and Engineering Co. Ltd.

OF all forms of illuminating engineering, there are few more interesting than the use of light for scenic displays and spectacular effects—such, for instance, as those afforded by the Searchlight Tattoo at the Wembley Stadium, and the reconstruction of the famous Zeebrugge expedition in the Admiralty Theatre, H.M. Government Pavilion, British Empire Exhibition. In such cases we have to deal, in one form or another, with projection effects. Sometimes it is merely a matter of floodlighting—the illumination of buildings or groups of people by a distant source. When the beam is not too confined (say not less than 15° dispersion), gasfilled electric lamps may be satisfactorily used, and these can be operated by dimmers. For a very concentrated beam an arc light is needed, and in this case dimming must be effected by means of a shutter in front of the projecting lens. This requires special design in order to ensure the mechanism not becoming clogged by expansion of metal owing to the heat; hence with a 40 amp. arc a design somewhat different from that used with the smaller lamps is desirable. With these two forms of projectors it is possible to do practically all that could be effected with the limelights formerly applied in the theatre. It is sometimes urged as an advantage that these limelights can be operated more gradually, and from an optical standpoint the continuous luminous surface is an advantage. And in some cases—as at Drury Lane Theatre—they form an historic part of the apparatus, regarded with a certain affection, and not lightly dispensed with.

At the works of the Strand Electric and Engineering Co. Ltd., in Floral Street, Covent Garden, we had the opportunity of seeing a wide range of electric projectors, of types successfully used in connection with the pageant events at Wembley and elsewhere. We were also given a demonstration of the latest modern types of footlights for stage effects—rows of gasfilled lamps equipped with varied colour-filters, run with dimmers, and enabling a very valuable transition in the colour of the light to be obtained. The use of gasfilled lamps with gelatine filters is now completely replacing the old battens of vacuum lamps with coloured bulbs. For many purposes the latest colour-sprayed lamps are extremely useful—for instance, in signs and exterior effects, where immunity from effects of the weather conditions is important. But the great range of colours obtainable with gelatines, and the ease with which new colours can be substituted, make them distinctly preferable for stage and pictorial effects indoors. Considerable attention has been also devoted to the design of the reflecting surface, curved about a horizontal axis with corrugations, or rather pits, to smooth out striations and give a wider throw. This is a feature of importance on the stage, where footlights have to be designed to avoid awkward upward shadows on the faces of actors, and on the scenery, which is sometimes of a delicate design. Spot-lights equipped with frames bearing gelatines in different colours are equally useful for concentrating light on some particular object. Both these and the horizontal troughs containing rows of lamps used as footlights are equally applicable to shop-window lighting, where colour is now beginning to play an important part. For stage and spectacular use, however, conditions are in some respects more exacting. For instance, one must provide efficient ventilation, and at the same time avoid any interstices through which rays of light can stray out. Similarly, in the case of pieces resting on the ground, wiring is preferably carried out at the back of the trough, rather than beneath it. Experience has shown that in the latter case insulation is liable to deteriorate owing to the wires becoming moistened when the stage is washed.

In conversation with Mr. Phillip Sheridan, Mr. L. G. Applebee and Mr. F. G. Macrae, one of the directors and two of the engineers respectively, who kindly demonstrated these various devices, the possibility of using projector-type gasfilled lamps for theatrical work was discussed. Within recent years very substantial progress in the design of incandescent lamps for projection purposes has been made, and for displays in small rooms, e.g., in schools, in the home or in small halls, incandescent lamps can now put up quite a creditable show. At present, however, opinion seems unanimous that when a very powerful beam or "spot" at a long throw is needed, as in many of the West End and Provincial theatres, the use of the arc is still inevitable.

We come next to a very fascinating field in the projection of light—the use of rocking and revolving apparatus to produce various illusions. The production of travelling clouds, rain and snow in panorama-views in this way is a familiar device, which we saw demonstrated. The simulation of a snowstorm brings out one interesting point. The effect is produced by the movement of a disc of sheet metal in which minute apertures are made, and experience proved that these must be irregularly distributed. One cannot imitate falling snow by a moving diaphragm with holes at regular intervals (natural snow does not form on this uniform plan!). Hence the holes are best pricked out by hand indiscriminately.

Less well known, probably, is the means of imitating fires. Needless to say, the burning of buildings following aerial attacks at Wembley, contrived by the Strand Electric and Engineering Co., does not involve any real destruction of property. The effect of flames is produced mainly by the projection of a moving pattern in orange and red, in front of which dark patches of travelling smoke are superimposed by the motion of glass with opaque patches on it. The collapse of portions of the building is meantime imitated by the fall of hinged scenery—all electrically operated. By the electrical ignition of small tanks of oil, artificial dense smoke can also be produced at will. A very lifelike picture of a moving sea can be projected by means of a coloured lantern-slide, behind which a sheet of grooved glass is systematically rocked. The apparent curling of the waves is particularly vivid. Similar methods can be applied to to the production of a species of projecting kaleidoscope, constantly changing patterns being depicted on the screen. Many such devices now play a part in kinema displays, where the use of light-effects to supplement the "story" is becoming common.

In the course of our visit we noticed many other ingenious devices, and we must not forget to mention the overhead "Arena" units, carrying gasfilled lamps in a concentrating "Sunray" glass reflector, and equipped with coloured gelatine films, to throw a flood of coloured light downwards. These units have been largely used in large halls on the occasion of balls, etc., where special light-effects are expected. Another familiar device in such cases is the rotation of large spheres carrying mirrors set at different angles, and illuminated by coloured beams from projectors. In this way a very gorgeous and scintillating "confetti" effect may be produced.

Not the least interesting item was the store of oddments in the basement, which are regularly loaned out to theatrical companies and taken on tour (not infrequently coming back somewhat the worse for the experience!). It is quite usual for people to arrive in haste demanding an electrically operated fitting to imitate an old-fashioned oil-lamp, or gas chandelier—even incandescent mantles have been electrically imitated! Thus, the manufacturer who caters for the stage is always engaged in efforts to meet unexpected and unusual demands, or contrive novel effects. He has, in fact, to deal with a phase of illuminating engineering as varied as it is arduous!

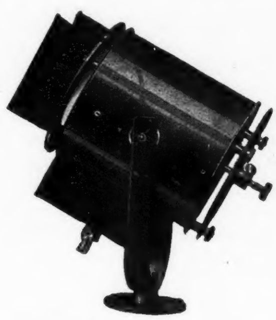
We understand that the Strand Electric and Engineering Co. Ltd. ("S.E.E.C.O.L.") was formed in 1913, so that, when the war period is deducted, this business, now employing close on 100 people, has been built up rapidly. We hope at some future date to reproduce illustrations of some of the special stage-lighting apparatus designed and made by the firm. Meantime the directors (Messrs. A. T. Earnshaw and Phillip Sheridan) deserve congratulation on their enterprise in this interesting work.

TRADE NOTES & ANNOUNCEMENTS

SPOTLIGHT PROJECTORS.

The "spotlight projector" is still comparatively a novelty in shop lighting. It serves a useful purpose when it is desired to emphasize some object in a shop window—especially when the colour of the projected light differs from that used for the general lighting.

The illustration shows a convenient form being listed by Messrs. Siemens and English Electric Lamp Co., Ltd. The type shown is suitable either for 100- or 250-watt lamps, and is furnished with a large silvered-glass mirror, 4 in. in diameter, mounted on an adjustable aluminium frame. Slots are provided to enable the position of the condenser lens to be altered, thus varying the diameter of the spot of light from 2 ft. to 10 ft. with a 10 ft. throw. An additional lens and diaphragm can be provided when still greater concentration of light is desired. Each projector is supplied complete with gelatine colour screen (either red, blue, orange, green or violet), which can be dropped into one of the slots in front of the lens.



A convenient form of Siemens "Spotlight" Projector for Shop-window Lighting, to emphasize certain objects in the window

THE EDISWAN BULLETIN.

An indication of increasing enterprise in the electrical industry is the variety of bulletins of a readable character now being published by leading firms. We have referred recently to *Holophane Illumination* and the Benjamin literature, and the *Osram Bulletin* is a familiar booklet which usually contains a good deal of illustrated data on lighting. The *Ediswan Bulletin* is yet another popular production, recently issued in a new form. The copy before us contains some notes on recent local electrical exhibitions, hints on primary batteries, notes of interest to the staff, and a topical cross-word puzzle. To a concern of any size a bulletin of this kind is a valuable asset. It means a good deal of work, but besides being a useful form of publicity it gives the staff an opportunity of knowing what the various departments are doing, and helps to promote personal relations between its members.

THE SIEMENS MONTHLY LIST.

The monthly price list issued by Siemens and English Electric Lamp Co., Ltd., is always a good example of condensed information. The September copy lists the standard varieties of lamps, and also manages to pack in particulars of a wide range of reflectors and glassware, "Zed" fuse fittings, wireless accessories, etc. The reverse page is devoted to wires and cables, batteries, sockets and switches. Such monthly lists serve a useful purpose. Customers are notoriously careless in displacing catalogues, but the arrival of a list each month acts as a constant reminder, and no doubt secures many orders that might otherwise be lost.

MAZDA PUBLICITY, 1925.

A leaflet under the above title summarizes the various Mazda leaflets, folders, etc., forming part of this season's publicity campaign. Amongst these the "Mazda Girl" items play a prominent part. The folder dealing with Mazda lamps is quite an effective production. A feature here is the array of "white," "daylight," and "colour-sprayed" lamps, the latter illustrated by coloured reproductions of the variety of shades available, ranging from blue to ivory.

FLOODLIGHTING OF MAGNET HOUSE.

The accompanying illustration shows the floodlighting of Magnet House, Kingsway, by means of a number of G.E.C. projectors equipped with gasfilled lamps, which are mounted on the opposite building. Attention is drawn to the uniform brightness secured, and the success with which the actual sources of light are concealed from the view of persons passing along Kingsway. The result seems to show the advantage of being able to mount the projectors at a considerable distance from the building illuminated; when these sources have to be placed quite close the problem becomes a somewhat awkward one, though experience shows that even in this case effective results can often be secured.

CONTRACTS CLOSED.

The following contracts are announced :—

MESSRS. SIEMENS and ENGLISH ELECTRIC LAMP CO., LTD.

Southern Railway; contract for the supply of Siemens Vacuum and Gasfilled Lamps for six months, from 1st September.

H.M. Office of Works: contract for the supply of Siemens Vacuum Lamps for a period of nine months from September 1st.

BRITISH THOMSON-HOUSTON CO., LTD.

Southern Railway; six months contract for the supply of Mazda Lamps.

GENERAL ELECTRIC CO., LTD.

The Admiralty; acceptance of tender for 99,100 Osram Vacuum Lamps, 3,161 Osram Gasfilled Lamps, and 150,700 Robertson Carbon Lamps.

Southern Railway; acceptance of tender for Osram Metal-filament, Vacuum and Gasfilled Lamps; also Robertson Carbon-filament Lamps, for a period of six months.

METRO-VICK SUPPLIES, LTD.

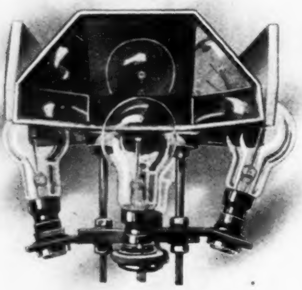
Admiralty; part contract for "Cosmos" Vacuum Traction type, Vacuum Ordinary type and Gasfilled Lamps.

ELECTRIC STREET LIGHTING FITTINGS.

The new catalogue lately issued by the Electric Street Lighting Apparatus Co. contains interesting information on the history of the company, which has developed from the work of Mr. Haydn Harrison, who, nearly a quarter of a century back, was devoting much of his time to electric street lighting. At the present time they are still carrying on continuous research on street lighting apparatus.

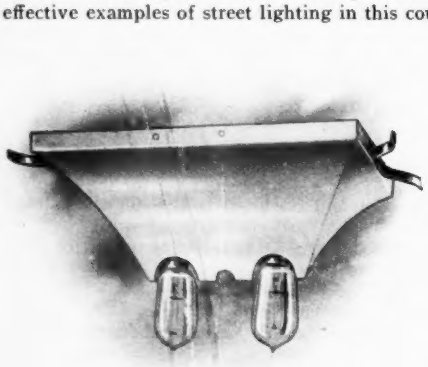
The many novelties and varieties of efficient apparatus described in the catalogue appear to be well adapted to comply with the varied requirements and to satisfy the somewhat divergent views on street lighting met with at the present time.

Thus, the efficient "Longitudinal Lighting" system is stated to increase the candle-power of the light source from ten to twelve times, thus producing in the desired direction 3,000 to 4,000 candle-power with 300 or 500-watt gasfilled lamps. We understand that this form of unit has been widely adopted for high columns throughout the country, and it is used in lighting many numbers of streets in London, Battersea, Hammersmith, Paisley, etc., and in important country towns, such as Portsmouth.



Croydon Fitting.

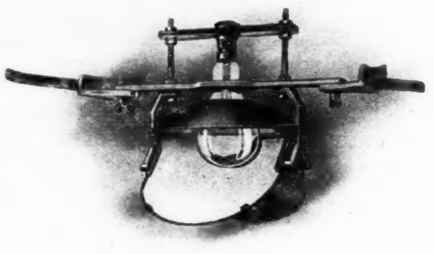
Other interesting developments include the Croydon type and Band Multiplier Reflector, which increases the power from three to five times. For this reflector it is claimed that the glare is not increased, as the reflections are from plane surfaces, thus reproducing the exact image of the light source without concentration; the effect being that of a group of lamps where only one actually exists. These are to be seen at Croydon and elsewhere, and are made in a form suitable for use in existing gas lanterns. Generally speaking, such lanterns are preferred to globe fittings, as the glass panes of a lantern are found to transmit the light with less absorption and distortion than is the case with the average globe used for the purpose. The company also manufactures diffusive lanterns, such as those they supplied for Oxford Street, London, which is quoted as one of the most effective examples of street lighting in this country.



"Marylebone" Conversion Fitting.

The contents of this catalogue and the numerous illustrations give evidence of much research on the problem of securing efficient distribution, coupled with a minimum of glare. Due consideration has been given to important details, such as permanency of reflecting surfaces, simplicity and low cost of maintenance, facilities for efficient cleaning. All electrical parts of the apparatus illustrated appear to be of the most substantial design and robust construction, in order to ensure reliability under all conditions of service.

Special interest attaches to the various devices for converting existing lanterns, several examples of which are illustrated. At the present time authorities are often reluctant to meet the expense of a complete new design of street lighting; hence there



L.L. Adaptor Fitting.

is a wide field for relatively inexpensive conversion apparatus, by which the efficiency of existing lanterns may be materially increased.

The catalogue also contains particulars of switches and other street lighting accessories, and should be distinctly useful to public lighting engineers.

SPECTACULAR LIGHTING OF THE EIFFEL TOWER.

A novel piece of spectacular lighting recently undertaken in Paris is the illumination of the Eiffel Tower by festoons of electric lamps. Anyone who has seen the tower will appreciate the magnitude of this work, much of which has to be done at a great height above the ground, and workers on the top of the tower were paid special rates up to 250 francs per hour. We understand that 24,000 Philips lamps were used, in addition to 21 miles of copper cable.

In passing, we may mention that we have received a comprehensive series of leaflets being issued by Philips Lamps, Ltd. Colour-sprayed lamps are illustrated in colour, whilst other leaflets deal with the special "Argenta" and "daylight" lamps, and with automobile lamps, of which, we understand, the Company makes rather a speciality. Another novelty is the Philips Rectifier, enabling wireless batteries, etc., to be charged off an alternating-current circuit. This is a very compact arrangement, which is claimed to be practically noiseless.

PHILIPS LAMPS, LIMITED.—ANOTHER BRANCH OFFICE.

We have to record yet another addition to the number of local branch offices being opened by Messrs. Philips Lamps, Ltd. The address of this office is: Philips Lamps, Ltd. (Cardiff Branch), 27, Womanby Street, Cardiff. Mr. A. H. Smith has been appointed Branch Manager.

STAGE LIGHTING FOR THE SHOP WINDOW.

As we go to press we have received from Messrs. Engineering and Lighting Equipment Co. Ltd. (St. Albans) attractive leaflets dealing with "Interzone" Reflectors for shop-window lighting, and also with the "Lunax" light-diffusing glassware. This form of glassware, which is available in a variety of pleasing shapes, is stated to be still more efficient than the "Monax" variety supplied by this firm. These enclosed units are considered entirely dust-proof, and yield soft shadows with freedom from glare; yet the efficiency is stated to be 85 per cent.

We have also received some particulars on an interesting installation at the Agricultural Hall, which was lighted up by Trent units during a recent exhibition. We hope to include a photograph of this installation, together with fuller particulars of the arrangements and results, in our next issue.

INDEX (September, 1925).

SPECIAL INFORMATION.

THE ILLUMINATING ENGINEER (the Journal of GOOD LIGHTING) was founded in January, 1908, and has thus been in existence for seventeen years.

SINCE the year 1909, when the Illuminating Engineering Society was founded in London, it has been the official organ of the Society.

IT is *the only journal in this country exclusively devoted to Lighting by all Illuminants.*

IT receives the assistance of contributors who are leading experts on illumination in this country and abroad. Foreign Notes and News will be a speciality, and correspondents have been appointed in all the chief cities of the world.

THE Journal contains *first-hand and authoritative information on all aspects of lighting;* it has also been improved and extended by the inclusion of a *Popular and Trade Section* containing special articles of interest to contractors, gas and electric supply companies, Government Departments and members of the Public.

DISCUSSIONS before the Illuminating Engineering Society which are reproduced in this Journal are participated in alike by experts on illumination and *users of light*, whose co-operation is specially invited.

Good Lighting is of interest to everyone. The Journal is read by engineers, architects, medical men, factory inspectors, managers of factories, educational authorities, public lighting authorities, and large users of light of all kinds.

BESIDES being issued to all members of the Illuminating Engineering Society, the Journal has an independent circulation amongst people interested in lighting in all parts of the world. The new and extended form of the Journal should result in a continual and rapid increase in circulation.

Every reader of THE ILLUMINATING ENGINEER, the Journal of GOOD LIGHTING, *is interested in illumination, and is a possible purchaser of lamps and lighting appliances. Gas and Electricity Supply Undertakings likewise benefit by the movement for Better Lighting, with which the Journal is associated, and which stimulates the demand for all illuminants.*

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